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ENERGY CONSIDERATION IN URBAN AND REGIONAL PLANNING

january, 1978

prepared for the CITY OF HAMILTON by the
PLANNING AND DEVELOPMENT DEPARTMENT
of the Regional Municipality of Hamilton-Wentworth

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FOREWORD

North American Cities have successfully resisted all attempts to build a coordinated, aesthetically pleasing urban environment. There was always enough land to go around and enough energy to take. When the man-made environment became unbearable, it was simply deserted, left to newcomers or left to total physical disintegration. In some instances dynamite was used as the solution. This era is slowly coming to an end. With the energy shortages and general environmental concerns, there will be less and less opportunity to run away. Urban problems will have to be faced and solved. Thus, we will ultimately arrive at a coordinated urban environment, one which is based not on the slippery ground of aesthetic speculations, but rather, on functional efficiency. As the reason and logic of the whole will determinate the role of an individual part, new aesthetics will emerge.

A great opportunity lies in the energy crisis; it should be recognized and be welcomed.

NEED FOR ENERGY CONSERVATION

Since energy considerations are relative newcomers to the planning field, let us remind ourselves of a few facts.

Traditionally, land use patterns and building designs have been neither a function of energy cost nor a function of energy availability. However, both architecture and urban development in North America have evolved in an energy rich environment and thus, energy conservation has not been a design constraint.

Energy - as any other commodity, is subject to market forces and pressures. For a long time and until very recently, energy has been a buyer's market and consumer's requirements were responsible for energy provisions. Even now Hydro is selling bulk for a discount price, encouraging a higher consumption of its product. But the situation is changing rather drastically, and we are emerging into a situation which could be described as a seller's market.

There are several reasons for this:

First - excess demand
Second - energy production
Third - the long term required to build production facilities

The result is that increasingly, users have to conform to energy availability.

The current energy awareness is manifested in the conservation ethic. This encompasses the voluntary restriction of general energy use and thorough protection against heat losses.

Actual solutions, however, lie in identifying the energy options available in a man-made environment, or, more specifically, in building design and in land use.

Before commencing any architectural or planning scheme, we should realize all the variables and factors affecting energy demand; our check list should include the following:

- functional efficiency
- maintenance
- the configuration design in relation to its climatic context
- thermophysical properties of the building materials
- the usage pattern

It might be instructive to use this check list and to review past land use patterns and the architectural forms which were evolved in energy scarce conditions. Perhaps we might learn a lesson in stuying the impact of energy shortages on land use planning and architectural and urban design.

These are the features of the past:

- In environmental extremes such as in cold Northern and in hot arid regions, building densities tend to be high and clustering is common.
- The functional mix is more dense in order to minimize trip distances.
- The size of cities (communities) is relatively small.
- Distribution of population is more even.
- High-rise structures are rare.

Certainly, it would be a mistake to try to imitate blindly past forms of survival struggles, but there might be some similarities in spatial solutions as the governing conditions become alarmingly alike.

Until very recently - with a generous supply of energy (bulldozer + heating/cooling), any site could have been made equal to any other site. Those days are definitely over.

Another important subject we have placed under the heading of energy consideration is Transportation.

Both common sense and history reveal that the result of restrictions on the availability of energy for the purposes of construction and the operation of human settlements is a physically closer relationship between a built space and its more intensive utilization.

In contrast to the high amount of energy required for bulk transportation (people, goods), only a relatively low amount of energy is required to convey information (ideas).

Conclusively, then, transportation as a common reaction to distance, should be replaced by an appropriate combination of land uses. In other words, we would make possible the greater availability of a wider variety of goods and services in a larger number of locations in lieu of present transportation costs. This arrangement is called a program of preventive transportation.

To complete our considerations of responsible energy use, we should mention the rather important subject of site planning and positioning of structures in relation to natural (macro-environmental) factors. Two of them, the major ones, must always be considered, the wind and the sun. Planner and architect are jointly responsible for an arrangement which would prevent excessive heat loss due to prevailing winds. All possible effort should also be made to avoid an asymetric solar heat load, one in which the side of the building facing south is constantly being fried by sun rays while the other side facing north is dead cold. It is rather difficult and costly to create balanced thermal comfort inside such a building, and actually, it rarely works. One example is City Hall in Hamilton.

Finally, one architectural rather than planning determinant of energy consumption should be mentioned here - the shape of the structure. The amount of heat loss (gain) is in direct proportion to the volume - surface ratio. In this respect, the sphere has superiority over all other geometrical forms. In areas where the conservation of energy is a most critical factor - such as in cases of environmental extremes - consideration of the shape of the structure is mandatory.

BUILDING DESIGN AND PLANNING

The need for a better utilization of energy, resources, and the environment is a recognized and generally accepted one. Recently collected data indicates that 20% of the total national energy consumption is used in residential buildings for space heating.

Conservation efforts are basically following two parallel paths:

-1- ATTEMPTS TO GENERATE LESS EXPENSIVE HEAT

Increasing the efficiency of existing systems and/or switching to alternative / renewable, "inexhaustible" / sources of energy

-11- ATTEMPTS TO MAINTAIN THE HEAT

Prevention of heat losses by a different spatial design and by the application of more efficient insultation

Improving the efficiency of existing heating systems of switching to more exotic energy sources is very important, but they make little sense as long as we are heating the sky instead of our homes.

Therefore, it is absolutely essential and of the first priority to ensure that the heat, however generated, is not wasted.

New properly designed, and ultimately insulated residential structures could reduce energy demand to 25%. By redesigning existing structures and by the proper application of additional insulation and double (triple) glazing, the present fuel demand could be reduced to 60%.

The owners and tenants of existing residential buildings are the most vulnerable to rising energy costs.

In order to lower energy needs and to preserve heat, it is important to design a building which complements and interacts with the climate. The first step is to utilize the energy of the sun without a complicated and sophisticated technology, this approach is called the use of Low Impact Technology or Passive Use. Surprisingly, applying measures of "L.I.T." results in lowering the demand to a point comparable to that of conventional houses equipped with sophisticated solar heating systems.

One example of "L.I.T." is an operable window as opposed to an inoperable window. The use of the latter is based on a disregard for the energy cost of heating / cooling - thermal comfort is centrally generated for the "average person" (since nobody is really average, nobody is really comfortable).

The basic requirements for buildings designed with the climate are the following:

-1- It must let warmth in when needed
It must let warmth out when not needed

-2- It must let coolness in when needed
It must let coolness out when not needed

Those two requirements could be accomplished by the orientation of the building. A certain construction of walls and windows, and a variety of shaping devices.

-3- It must store the heat/cool for a time when needed
This can be accomplished by the use of heavy construction materials (stone, concrete, bricks).

-4- It must not let the heat/cool escape
This can be accomplished through insulation, reduction of air infiltration, storm windows, shutters, etc.

Those abovementioned requirements fall into three basic categories of performance.

The building must be able:

-1- To receive the heat/cool from the surroundings
-2- To absorb the heat/cool
-3- To retain the heat/cool

The present awareness and conservation ethic is manifested in recommendations of how to increase thermal comfort (and thus reduce energy consumption) by the simplest means. These are usually listed as follows:

- Turn down the thermostat whenever possible
- Draw the curtains
- Pull the shades
- Close the venetian blinds
- Weatherstrip windows and doors
- Close the shutters
- Put on storm windows
- Maintain and tune the furnace
- Wear long underwear
- Have temporary windbreaks during winter

A consideration of energy conservation in building design would result in a decreasing demand for heat. This means that the effective size (not necessarily actual) of the building would be reduced and, therefore, the mechanical equipment and back-up systems could be reduced.

PERFORMANCE REQUIREMENT NO. I. :

Capability of the building to collect heat/cool from its surrounding.

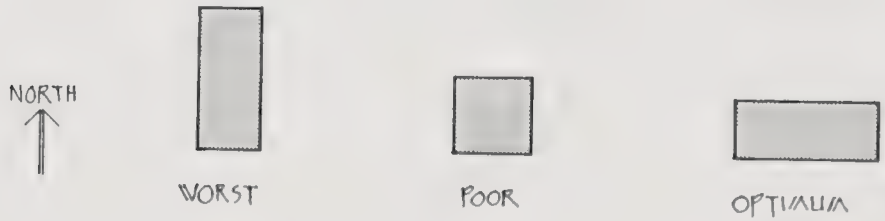
-1- Orientation towards the sun

Windows allow a significantly greater gain than walls. Therefore, it is important that windows should be oriented southward, (depending on the geographic location, of course; in Egypt this recommendation would create a disaster).

In upper latitudes (40^0 N+) south sides of buildings receive twice as much radiation in winter than in summer. The east and west receive two and one half times more in summer than in winter.

In lower latitudes (35^0 N-) south sides of buildings receive more than twice as much radiation in winter than in summer. The east and west walls receive twice to three times more radiation than the south ones in the summer..

Obviously, from the point of view of receivership an elongated shape house with its longer axis paralleling a north-south direction would have the worst possible orientation in any season. Similarly, a square house oriented in any direction would be little better. The best (or optimum) orientation would be an elongated shape with its longer axis parallel to the east-west.



-2- Orientation away from the wind

Wind is the most important factor which determines the amount of air which penetrates into the building. A change in the wind from 5 mph to 20 mph doubles the heat loss in the house.

Many experiments have indicated that fuel could be saved up to 30% if the house is protected on three sides (west, north, east). Obviously, it should therefore, be mandatory that a building should be oriented away from the prevailing winds (in our northern hemisphere, prevailing winds are north-west) or screened by natural or planted vegetation or man-made barriers.

Furthermore, entrances should not be located on the north-west side of the house. It is also important to reduce uncontrolled air infiltration, such as penetration through cracks, air spaces in the walls, roofs and windows. A good practice is to add building paper between the plywood sheeting and the exterior siding (wherever applicable).

PERFORMANCE REQUIREMENT NO. 2

Capability of the building to absorb heat/cool.

Different materials differ in their ability to accept and maintain thermal charges. Lightweight buildings respond quickly to changes in outdoor temperatures (corrugated metal shelters). Unfortunately to design heavy buildings is to contradict the current approach. (One engineering design principle: "Do more with less"; Mies Van De Rohe's dictum: "Less is more"; B. Fuller's challenge to the construction industry in the early twenties:"How much your buildings weigh?").

Heavy buildings require more material; thus, the cost of the additional material (the cost of labour and the energy to manufacture it) has to be compared with the cost of the energy saved.

Standard computations of the cost of a building include only the initial expenses. They do not include the cost of energy consumption. A realistic picture of the actual cost could only be arrived at by employing life cycle costing methods. (The sum of the initial costs, plus the cost of upgrading and maintenance of the system over its life).

PERFORMANCE REQUIREMENT NO. 3:

Capability of the building to retain heat/cool.

The following are the fundamentals of keeping heat within a building:

- the shape of the building
- wind protection
- window and entrance types (air locks)
- insulation
- the reduction of air infiltration
- heat recovery (heat pump)

LEGAL ASPECT OF THE DIRECT USE OF SOLAR ENERGY

There are convincing indications that the direct use of solar energy (radiation) will play an important role in our everyday lives as soon as the early eighties. Interestingly enough, or should we say, paradoxically, the application of the direct use of solar energy in the housing field could make possible - at least in some locations and for some time - the further perpetuation of low density, suburbian forms of accommodation. Those who have a vested interest in this anachronistic and environmentally damaging land utilization are cheering the advent of solar collectors and other systems of "low impact technologies" for heating and cooling individual homes. In the United States, millions of dollars are being poured in that direction.

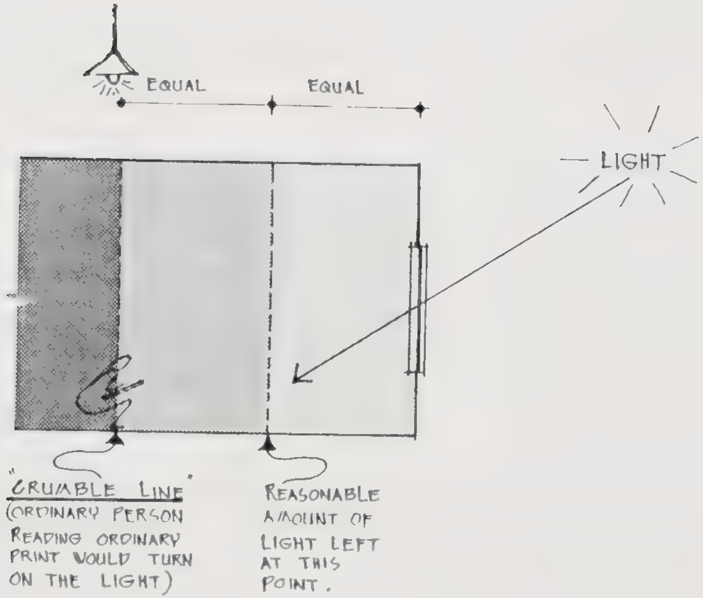
Thus, whether in suburbia or in the downtown, direct harnessing of solar rays is going to take place as a major contributor to the easement of the demand on the central energy distributing network. New types of problems and potential conflicts will arise and new planning regulations and amendments will necessarily be introduced. Whether it be new regulations or new amendments to existing ones, both will have to be based on a sound knowledge of the technology and its associated problems.

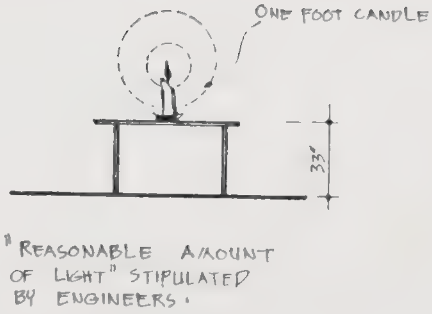
The fundamental problem of the introduction of solar energy is not as much a technological one as a legal one. It lies in solar light access. This right to light has been treated differently at different times and places.

The old Latin Maxim: Cujus est solum ejus est usque ad coelum et ad inferos (he who owns the soil owns also the sky and to the depths), has been incorporated by all the nations of Euro-American civilisation. There are obviously some minor limitations; for example, one cannot shoot down an Air Canada passenger plane just because of property trespassing.

Secondly, a very important historical precedent is the pre-industrial English doctrine of Ancient Lights. In essence, this doctrine stipulates that if you enjoy light coming over a neighbour's property for a certain length of time, you are entitled to it. The "certain time" was established in 1623 as 20 years and in 1959 it was extended to 27 years. However, to establish the meaning of "reasonable enjoyment" of light is rather difficult.

To determine that, English engineers went through a series of very cumbersome acrobatics. They invented the "grumble line", which points out exactly where a substantial deprivation would occur.


EQUAL
EQUAL
LIGHT
"CRUMBLE LINE"
(ORDINARY PERSON READING ORDINARY PRINT WOULD TURN ON THE LIGHT)
REASONABLE AMOUNT OF LIGHT LEFT AT THIS POINT.



The doctrine of Ancient Lights is difficult to enforce, especially in fast growing urban areas. It was flatly rejected by U.S. judges in the 19th century (New York 1838).

The Canadian standpoint on this matter is not quite clear (at least to the author of this report).

It should be noted, however, that on the municipal level in both Canada and the United States, zoning ordinances are, or could be, an appropriate vehicle for executing the old English Doctrine or a revised form of it. That is a control of height, bulk and the stipulation of setbacks. Unfortunately, physical control through zoning in its present form reflects only the highly misunderstood European architectural theories of the twenties; they are obviously not written with solar rights in mind and finally, there is limited protection against zoning changes.

The following are the avenues potentially available to owners of land to ensure their light rights without their buying the adjacent properties:

-Affirmative Easement-

The owner can purchase the easement as a part of other legal interests in reality. He buys the right to enter the property (to the extent specified in the easement). This right does not change with a change in ownership.

-Negative Easement-

The owner of this easement cannot enter the land, but he can prevent a development of the adjacent land which might adversely affect the enjoyment of his own property.

Unfortunately, in densely developed areas, the cost of an easement could be equal to the cost of the land.

There are other possibilities:

- The air space could be nationalized by the Federal Government and leased to property owners subject to specified conditions.

- The Federal or Municipal Government, through zoning (or other ordinances), can establish "solar zones" in the same manner as they stipulate existing requirements for setbacks and height. Ideally this should also include provisions for harnessing indirect forms of solar energy (such as wind, water thermal gradients, bioconversions, greenhouse food production, large solar energy plants, etc.)

To summarize, rights to direct solar energy should be established by:

-1- Easements - in the absence of other protective ordinances
-2- Covenants - light and air easements over lands in large scale developments
-3- Zoning - extended form of present zoning which would incorporate the access of light to a property by stipulating the geometry of the space over the property to be developed. This could be implemented as:

i) blanket policies (large scale)
ii) individual rezoning applications

in addition to that, a system has to be developed for compensation and enforcement (in combination with antipollution and nuisance by-laws).

The preservation of solar rights falls into two major categories which follow two historical doctrines. Those rights could be implemented and enforced to a large degree by existing or by existing/modified by-laws:

-1- Light Above the Land

-a- Trespassing Laws - entering one's air space; such as man-made structures, trees, fences etc. (not airplanes, however)
-b- Environmental Protection Laws - smoke and pollution originating elsewhere is entering one's air space.
-c- Nuisance Laws - various kinds of pollution could be considered as "nuisance". There are still difficulties in proving it and collecting reimbursements.

-2- Light From Above Adjacent Lands
(this right generally does not exist in the U.S.)

-a- Nuisance Laws -	the reflective surfaces of adjoining buildings or solar collectors; trees, fences and other man-made structures
-b- Easements -	acquisition of an easement or purchase of light and easement, or trading and exchange of easements.
-c- Covenents -	in large developments, the original owner can place restrictions on individual parts of lots.
-d- Zoning -	existing controls of mass, weight, and bulk could be expanded to include light rights.

Above and beyond the existing legal machinery, it is possible, when deemed necessary, to design and adopt special laws related to solar rights and to the harvesting of solar energy (New Mexico, Colorado, Oregon).

Other possible methods of implementation:

- Property tax Incentives -

-i- solar heating/cooling equipment is assessed as a comparable conventional unit (Indiana, Illinois, Maryland, Oregon, South Dakota)
-ii- solar devices tax reduced to 5% (from normal 30%) (Colorado)
-iii- complete tax exemption for capital investments in any non-fossil form of energy generation (Arizona, Montana, North Dakota).

- Insulation Tax Credit for Property Owners

- Other Tax Incentives -

  -i- tax credits on the installation of qualified systems
  -ii- business investment tax credits for solar (or other alternative energy) equipment used for commercial and industrial developments
  -iii- tax credits to insulation manufacturers.

- Life Cycle Costing. Mandatory for every development and the mortgage must be computed on that basis. (Life cycle costing is in principle the sum of initial costs plus the cost of upgrading and maintaining the system over its life).

- Building Codes and Subdivision Regulations. This could include certain mandatory requirements and features, such as, orientation, door and window construction, zonal heating, greenhouse, etc.

- Electricity Pricing. Utility companies should set rates which reflect the peaks of consumption, and introduce incentives for saving rather than spending.

- Sound Transportation Plans which encompass energy saving concerns.

MUNICIPAL AND REGIONAL SCALE CONSIDERATION

The urgent problems we are facing today are not uniquely Canadian or Hamilton-Wentworthian. The whole civilized world is engaged in discussions related to our present consumption habits. The only local difference might be in the degree of recognition of the problem. It appears that on the urban and regional scene, the conflict lies between the conservation of natural resources and urban and regional growth. By "growth" we usually mean the narrow frontier understanding of growth, i.e., continuously grabbing more and more land and constructing some structures here and there which are generously separated by not - or under - used green (or black) surfaces.

Perhaps the basic issue should be rephrased to _"we have a choice between continuing our present consumption patterns and lifestyles and changing our consumption habits and lifestyle to more resource-conserving styles"._

This, unfortunately, is regarded as a _threat_ rather than an opportunity. Taken from this narrow point of view, the conclusion is that people will only reluctantly sacrifice low density living and the private use of their automobile in favour of evergy conservation. On the other hand cities which fascinate North Americans and which are literally polluted by North American tourists were usually built in energy-constrained situations and are often maintained under similar conditions to the present.

The introduction of energy concerns into urban and regional planning should be administered (as much as possible) through existing regional and municipal plans. Every such plan is inundated by seemingly harmless "motherhood" statements (otherwise it would never be approved) such as:

> Goal:......Region that provides a variety of opportunities, choice of lifestyles and quality of environment....
>
> Objective:......To conserve and use natural resources for their most beneficial use....

Perhaps now is the opportunity to use such non-binding, general goals and objectives in a binding and concrete fashion by developing and adopting proper policies and enforcement methods.

In order to formulate such public policy, it is necessary to know:

- what energy sources are being used; and
- which activities are consuming those energy sources

At the present time it is difficult to present a precise picture or a balance sheet, as we do not have reliable statistics at hand. To an intelligent observer, it appears that the following types of energy are consumed the most:

- electricity	)	
- natural gas	)	space and water heating/cooling
- oil	)	
- gasoline		transportation

The energy pattern in industrial and commercial processes seems to be rather complex to assess; refineries, for example, are generating their own power; the generation and transmission of electricity is very wasteful; there is almost a 2/3 loss of energy in the production and transmission of power for the metropolitan Washington Area.

As these problems are being recognized, monitoring systems and methods are gradually being developed to assist large scale physical planning.

Energy considerations in the planning process usually follows five basic steps:

-1- Development of energy use (flow, throughput) pattern in the given area.
-2- Postulate all ways in which land use planning or better, physical environment planning, could conserve resources and energy.
-3- Development of energy efficient alternatives.
-4- Evaluation of all alternatives on a "cost-benefit" basis.
-5- Select the most suitable alternative.

Any form of energy consideration in planning leads towards similar conclusions. There is no doubt that we should effectively prevent urban sprawl. The cost of urban sprawl has been intensively researched. Results show, for example, that high density developments can conserve energy in two ways:

- up to 65% on space heating/cooling
- up to 60% on transportation (reduced demand)

There is no design, engineering or technological problem to build an energy efficient physical (urban) environment. A solution has to be found as to what is to be done with the present energy inefficient urban pattern.

It is a two-fold, politically difficult to digest task:

- to stop further development on the existing pattern
- to restructure or rebuild the existing pattern

One of the most efficient methods of restructuring the existing urban environment is by "urban renewal" type of surgery. The major problem is not a social one as is often incorrectly presented, but rather a financial and managerial one. It requires heavy financial "front-end loading" and stage planning (phasing). Expertise in these areas is scarce.

Another method is to accomplish the energy conservation objectives on a piecemeal basis. Although this method is less efficient overall and more expensive, it is, on the other hand, politically more acceptable at present time.

In any case the pre-requisites are:

- strong commitment to energy conservation objectives
- public awareness ofthe problem and the available solutions
- invention of implementation methods

Summary of Development Pattern, alternatives and characteristics in the formulation of land use plans as a function of energy consumption.

-1- larger development, larger capital spending, compact development at higher densities, (this is particularly important for economizing on labour, materials and energy in construction).

-2- utilization of the natural amenities of sites (to reduce heating, cooling and lighting loads).

-3- continuous development (savings in maintenance and operation; efficient coverage of an area means shorter distances and this means less energy spent on communal services such as police and fire patrols, school bus routes, private delivery, etc.)

-4- clustering and elimination of leapfrog development (limits wasteful travel, servicing, etc.)

-5- mixed land use (reduces demand for travel, makes possible multipurpose trips, use of the public transit system, reduces size of required land and lowers the cost of labour, material and time per square (cubic) unit of the construction).

-6- use of sophisticated technologies and certain technical options(certain energy saving technologies can be used on rearranged- reorganized uses of land at certain densities such as total energy systems, use of waste heat, recycling wastes, etc.)

-7- orientation to public transportation and gradual substitution of transportation by land use arrangements (preventive transportation).

The following are the available avenues for the implementation of energy conservation policies in urban growth management:

- provincial legislation - the Planning Act; provincial objectives; local authorities controlling annexation and developments at the periphery of the city;

- regional plan - control of supply of land for development; energy efficient regional land use plan;

- municipal powers - legislative control over forms of development through the "Planning Act" and "Municipal Government Act"; zoning; development control; issuance of building permits; development agreement;

- indirect controls -	public sector of economy; transportation and utility system phasing; development of secondary public facilities; education; health care; government incentives programs; taxation;

CONCLUDING REMARKS

Energy considerations present an important and exciting new domain for planners' attention. The developments in energy fields should be carefully monitored insofar as energy is going to play a crucial role in shaping and reshaping our urban environment.

Historically, the cost of energy has always shaped our buildings, cities, settlements and our lifestyles. During the last quarter century (a rather unique and unheared of phenomenon) the wastefulness we acquired naturally and logically reflected the energy cost.

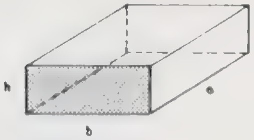
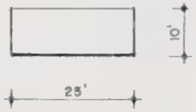
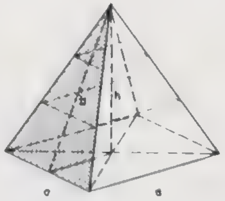
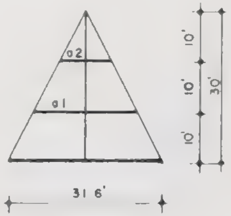
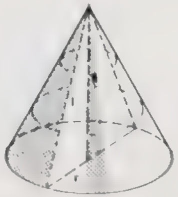
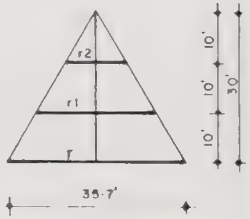
It was very low.

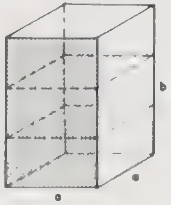
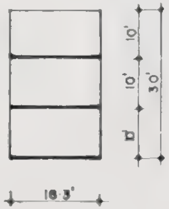
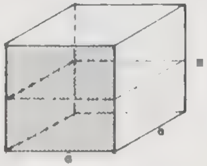
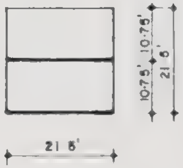
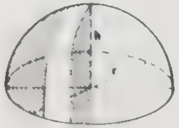
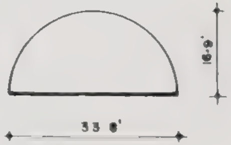
APPENDICES

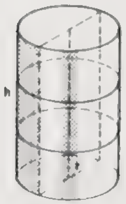
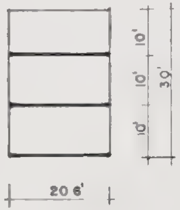
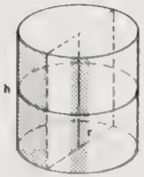
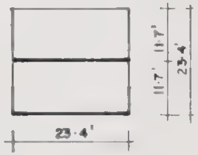
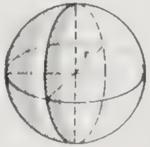
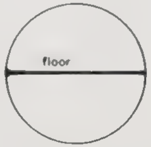
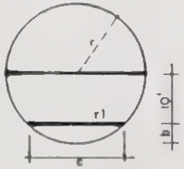
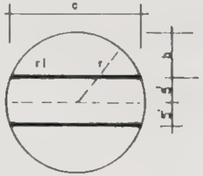
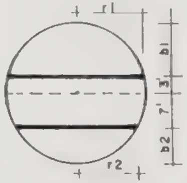
APPENDIX "A"

The next table shows the relationship between the volume and surface area of different geometric forms. It should be understood that there is a difference if the particular form is used for the storage of milk or to house people. The sphere or the cone might look like a sound proposition from the energy conservation point of view, but when these shapes are divided to accommodate man and his needs, the interior design becomes a tricky problem. To illustrate this, a parallelopiped of 10,000 cu.ft. has been chosen as a meter. This represents a 1,000 sq.ft. (24 x 40 ft) bungalow type house. All other geometrical shapes have the same volume (1,000 cu.ft.) but their surface area differs. As everybody is familiar with the spatial comfort of a 1,000 sq.ft. bungalow, it is easy to relate to other geometrical shapes. Further, where applicable, solids were divided horizontally in 10 ft. high floors to show potential floor areas for man's use. Thus, the problem of selecting a suitable form is better illustrated and hopefully better understood.

COMPARISON CHART OF VOLUMES AND SURFACES OF SELECTED SOLIDS

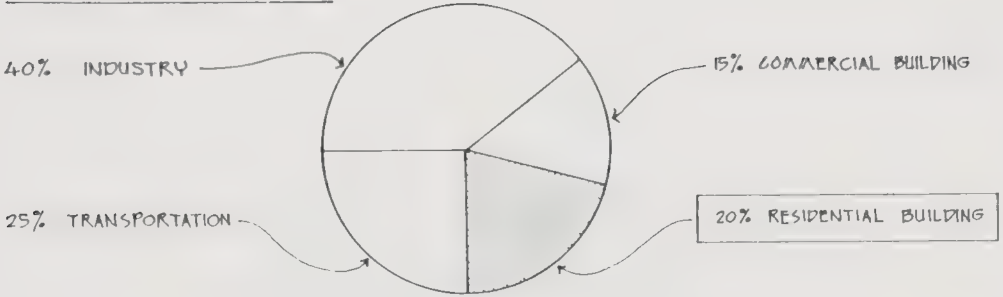
	SHAPE	VOLUME	SURFACE	POSSIBLE FLOOR SPACE	VOLUME SURFACE EFFICIENCY
1	PARALLELOPIPED no. 1  h = 10' a = 40' b = 25'	10,000 cu.ft.	3300 sq. ft.	1000 sq. ft. 	68·01 %
2	PYRAMID  h = 30' a = 31.6' b = 33.9'	10,000 cu.ft.	3144·7 sq. ft.	1555·5 sq. ft. a1 = 21·1' a2 = 10·5' 	71·37 %
3	CONE h = 30' r = 17·8' l = 34 9' 	10,000 cu. ft.	2956·4 sq.ft.	1555·5 sq. ft. r1 = 11·9' r2 = 5·9' 	75·92 %

	SHAPE	VOLUME	SURFACE	POSSIBLE FLOOR SPACE	VOLUME SURFACE EFFICIENCY
4	PARALLELOPIPED no. 2  a = 18·3' b = 30'	10,000 cu ft.	2857·5 sq. ft.	1000 sq. ft. 	78·55 %
5	CUBE  a = 21·5'	10,000 cu.ft.	2784·9 sq.ft.	928·3 sq.ft. 	80·60 %
6	HEMISPHERE  h = 16·9' r = 16·9'	10,000 cu. ft.	2676·1 sq.ft.	892·0 sq. ft. 	83·87 %

	SHAPE	VOLUME	SURFACE	POSSIBLE FLOOR SPACE	VOLUME SURFACE EFFICIENCY
7	CYLINDER  h = 30' r = 10·3'	10,000 cu.ft.	2608·1 sq. ft.	1000 sq. ft.  	86·06 %
8	RIGHT CYLINDER  h = 23·4' r = 11·7'	10,000 cu.ft.	2569·5 sq.ft.	856·5 sq.ft.  	87·35 %
9	SPHERE  r = 13·4'	10,000 cu.ft.	2244·6 sq.ft.	 561·2 sq. ft.  808·16' sq.ft. b = r - 10 = 3 4' c = 17·7' r1 = $\frac{c}{2}$ = 8·9'  965·24 sq. ft. c = 24·8' r1 = $\frac{c}{2}$ = 12·4' b = 8·4'  940·11 sq ft. b1 = r - 3 = 10 4' b2 = r - 7 = 6 · 4' r1 = 13·0' r2 = 11· 4'	100 %

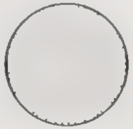
APPENDIX "B"

TOTAL ENERGY CONSUMPTION



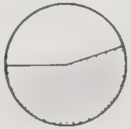
ENERGY CONSUMPTION IN RESIDENTIAL BUILDINGS:

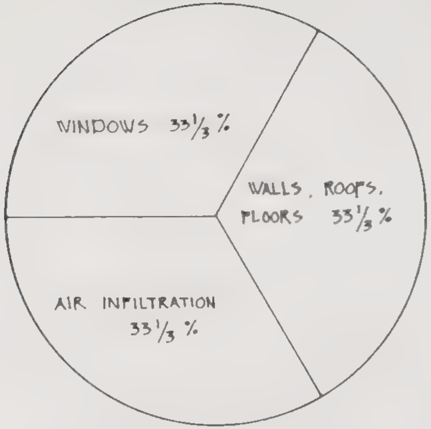
IF THE ENERGY CONSUMPTION IN EXISTING STRUCTURES- BUILT DURING LOW COST ENERGY TIMES IS TAKEN AS 100%



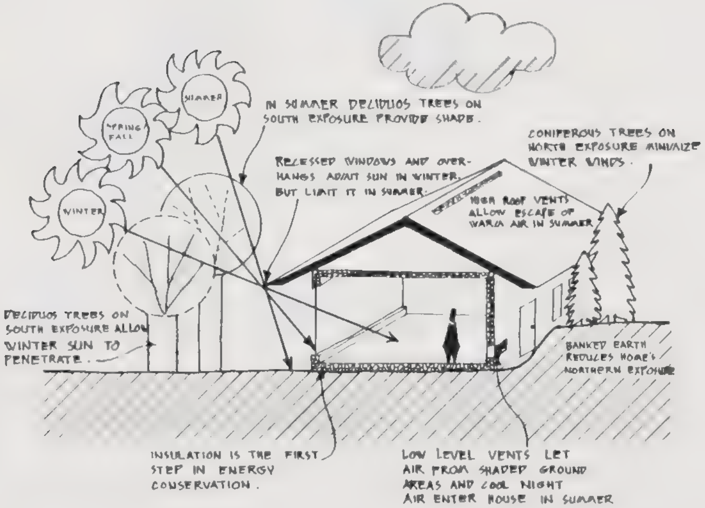
THAN THE ENERGY CONSUMPTION IN NEW STRUCTURES- DESIGNED WITH THE ULTIMATE APPLICATION OF TO-DAY'S KNOWLEDGE, COULD BE REDUCED TO 25%

THE ENERGY CONSUMPTION IN EXISTING STRUCTURES-REDESIGNED/ ADDITIONAL INSULATION AND GLAZING/ COULD BE REDUCED TO 60%

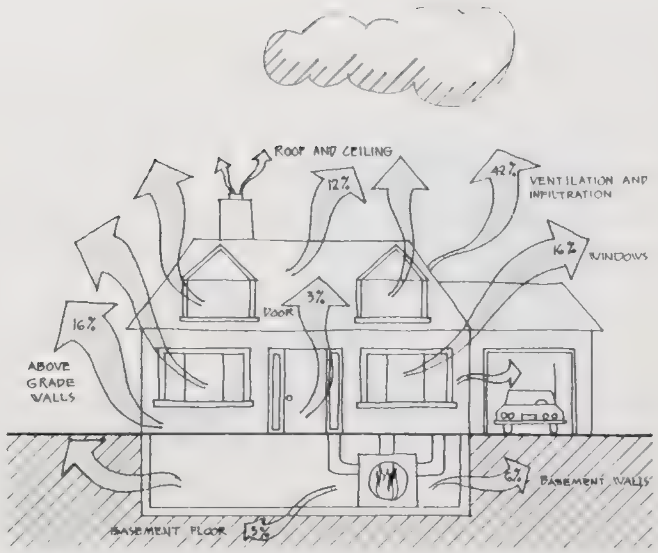




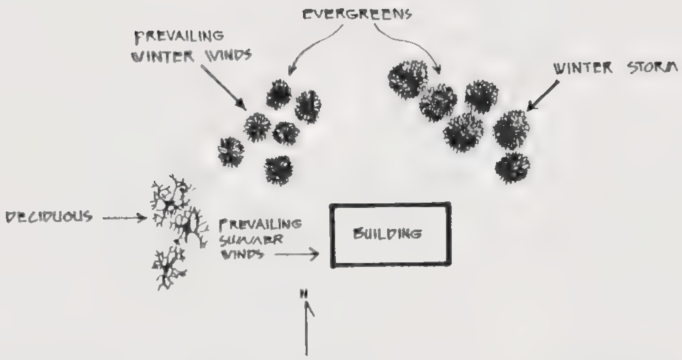
APPROXIMATE DIVISION OF HEAT LOSS FOR CONVENTIONAL HOUSING.


SUMMER
SPRING FALL
WINTER
IN SUMMER DECIDUOS TREES ON SOUTH EXPOSURE PROVIDE SHADE.
RECESSED WINDOWS AND OVERHANGS ADMIT SUN IN WINTER, BUT LIMIT IT IN SUMMER.
CONIFEROUS TREES ON NORTH EXPOSURE MINIMIZE WINTER WINDS.
HIGH ROOF VENTS ALLOW ESCAPE OF WARM AIR IN SUMMER
DECIDUOS TREES ON SOUTH EXPOSURE ALLOW WINTER SUN TO PENETRATE.
BANKED EARTH REDUCES HOME'S NORTHERN EXPOSURE
INSULATION IS THE FIRST STEP IN ENERGY CONSERVATION.
LOW LEVEL VENTS LET AIR FROM SHADED GROUND AREAS AND COOL NIGHT AIR ENTER HOUSE IN SUMMER

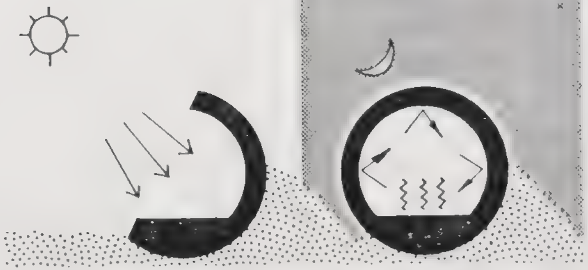
A PASSIVE SOLAR SYSTEM



SEASONAL HEAT LOSS FROM TYPICAL HOUSE.



PROPER SITING FOR WIND PROTECTION TO SAVE ENERGY (ASSUMING WIND DIRECTIONS AS SHOWN).

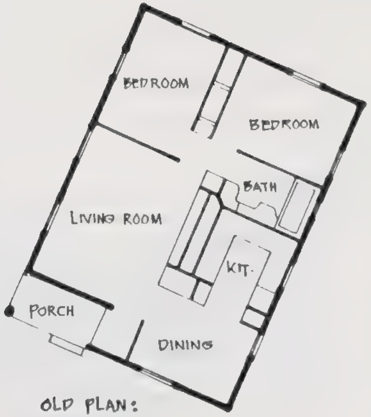


SUNNY WINTER DAY: BUILDING OPENS UP TO ABSORB HEAT.

WINTER NIGHT: BUILDING CLOSES ITSELF UP, LIKE A COCOON

DIAGRAMS OF HOW BUILDINGS SHOULD PERFORM AS SOLAR HEAT COLLECTORS, STORAGE DEVICES AND TRAPS.

COMPARISON OF EFFECTS OF SOLAR RADIATION ON A HOUSE IN TWO PERPENDICULAR ORIENTATIONS.



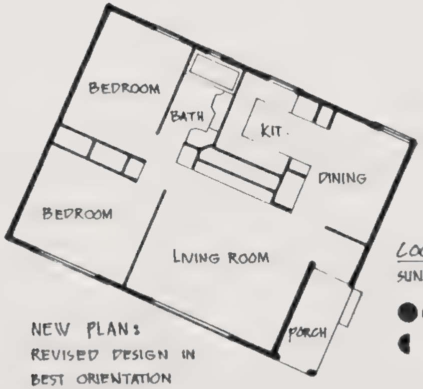
OLD PLAN:
ORIGINAL DESIGN IN
WORST ORIENTATION

HOT IN SUMMER:
SUN-HEAT IN LIVING ROOM

●●●●●●◖ MAX
●●●●◖ AVERAGE

COLD IN WINTER:
SUN-HEAT IN LIVING ROOM

●●◖ MAXIMUM
●◖ AVERAGE



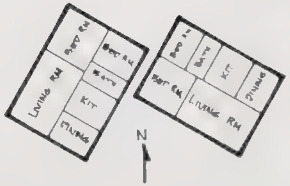
NEW PLAN:
REVISED DESIGN IN
BEST ORIENTATION

COOL IN SUMMER:
SUN-HEAT IN LIVING ROOM

●◖ MAXIMUM
◖ AVERAGE

WARM IN WINTER:
SUN-HEAT IN LIVING ROOM

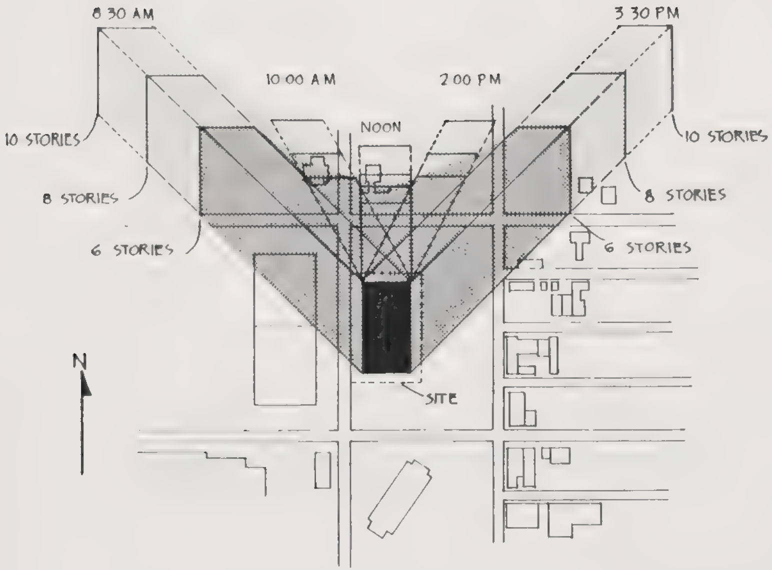
●●●●●●●●●◖ MAX.
●●●●● AVERAGE.



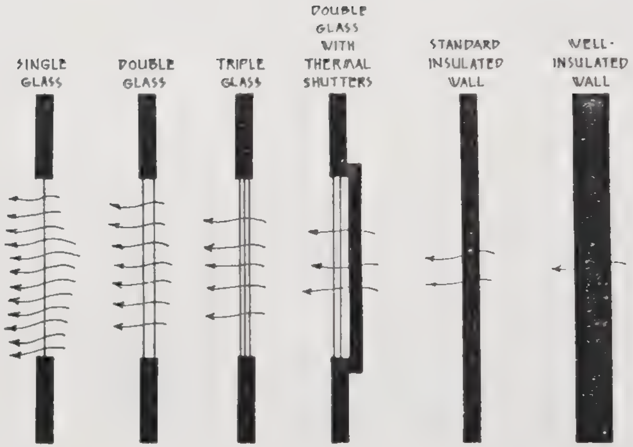
SUN HEAT IN LIVING ROOM

WORST	BEST
SUMMER	
●●●●●●◖ MAX	●◖ MAX
●●●●◖ AVERAGE	◖ AVERAG
WINTER	
●●◖ MAX.	●●●●●●●●●◖ MAX
●◖ AVERAGE	●●●●● AVERAGE

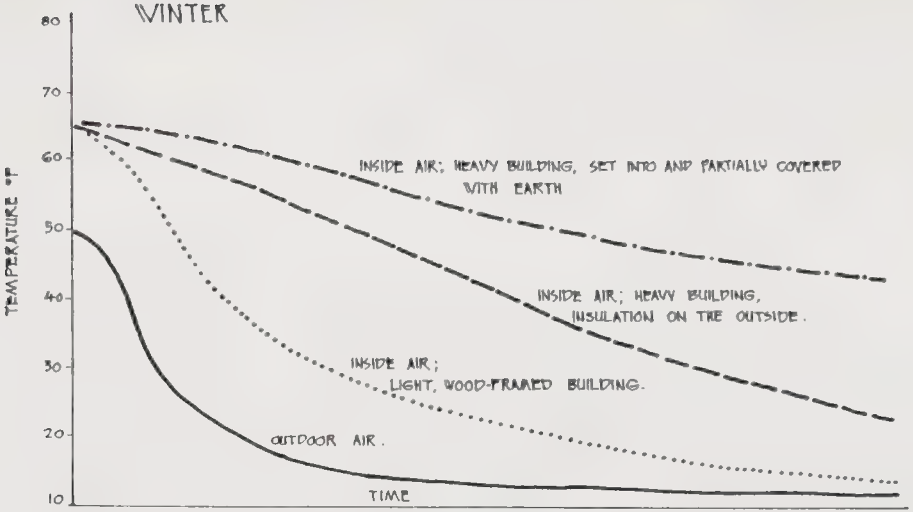
EFFECT OF HOUSE ORIENTATION AND DESIGN ON POTENTIAL SOLAR HEAT GAIN.



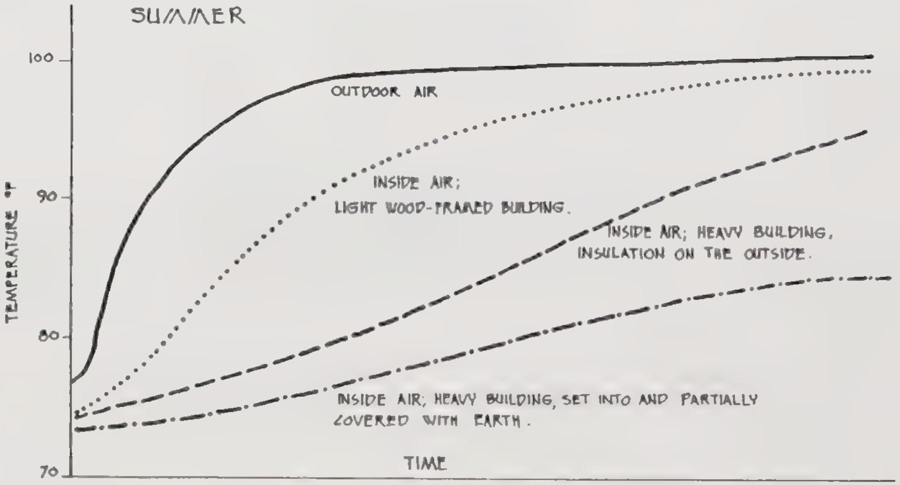
COMPOSITE SHADOW: FOR 6 STORIES (78'), 8 STORIES (104'), 10 STORIES (130'), DEC. 21, 8:30 AM. TO 3:30 P.M. (SUN TIME).



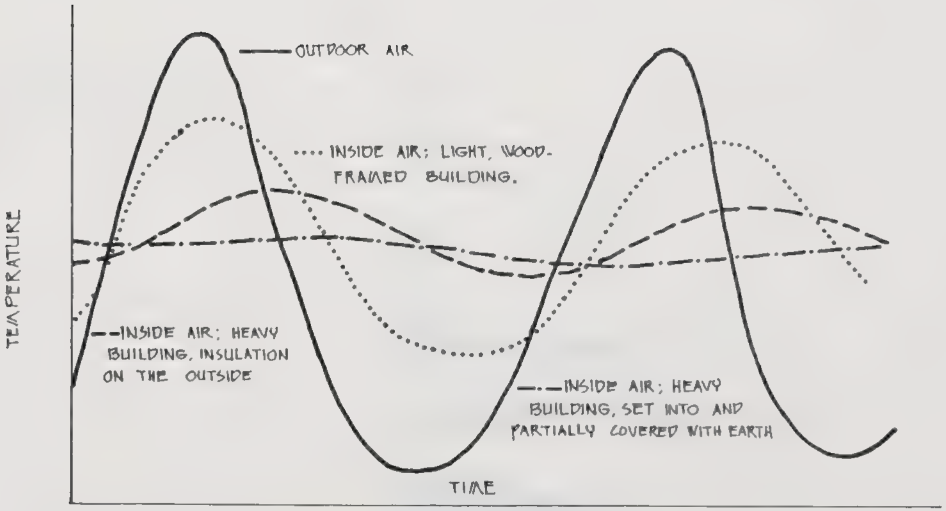
RELATIVE AMOUNTS OF HEAT LOSS FOR VARIOUS TYPES OF WINDOWS AND WALLS.



EFFECT OF A DROP IN OUTDOOR TEMPERATURE ON INDOOR TEMPERATURE FOR VARIOUS CONSTRUCTION TYPES ASSUMING NO SOURCE OF HEAT ENERGY WITHIN THE BUILDING.

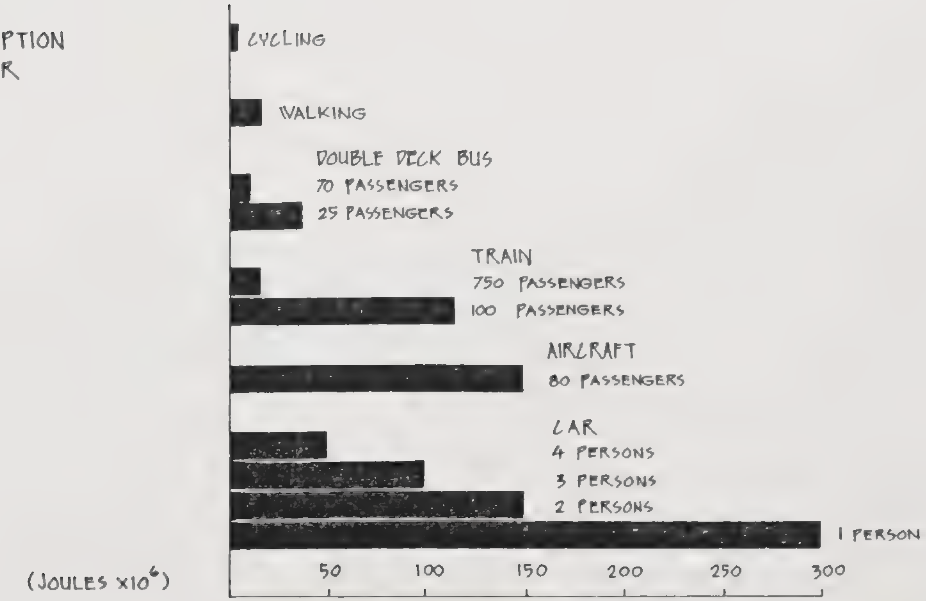


EFFECT OF A RISE IN OUTDOOR TEMPERATURE ON INDOOR TEMPERATURE FOR VARIOUS CONSTRUCTION TYPES ASSUMING NO SOURCE OF COOLING ENERGY WITHIN THE BUILDING.



EFFECT OF FLUCTUATIONS IN OUTDOOR TEMPERATURE ON INDOOR TEMPERATURE FOR VARIOUS CONSTRUCTION TYPES ASSUMING NO SOURCE OF HEATING OR COOLING ENERGY WITHIN THE BUILDING.

TRANSPORT ENERGY CONSUMPTION IN JOULES/PERSON/100 KM, FOR VARIOUS TRAVEL MODES.



The following table is an adaptation of energy conservation recommendations developed by the American Association of Mechanical Engineers. It can be used for the formulation of specific recommendations for the Hamilton-Wentworth Region, or used in its present form. An evaluation column was added to show how a development in question is energy efficient. In addition, a point system can be used, and the minimum number of points necessary for approval can be stipulated.

Note:

Heating Degree-days are the number of degrees when the daily average temperature is below 65°F.

A day with an average temperature of 50°F has 15 heating degree-days (65-50=15), while one with an average temperature of 65°F or higher has none. The degree-day sum for a period of days represents the total heating load for that period. The relationship between degree-days and fuel consumption is linear.

A CHECKLIST OF ENERGY CONSERVATION OPPORTUNITIES, RANKED IN PRIORITY ACCORDING TO CLIMATIC CONDITIONS.

PRIORITY
1
2
3
0 NOT APPLICABLE

SOURCE: SOLAR HEATING AND COOLING by JAN F. KREIDER and FRANK KREITH.

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6 000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4 000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS					
	sun 60% of daylight time or more wind 9 miles/hr. or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
																		4	3	2	1	0
SITE																						
1. Use deciduous trees for their summer sun shading effects and wind break for buildings up to three stories	1	2		3								0	1	2	3		0					
2. Use conifer trees for summer and winter sun shading and wind breaks		0							2	3		1	1	2	3		0					
3. Cover exterior walls and/or roof with earth and planting to reduce heat transmission and solar gain	1	2		3								0	1	2	3		0					
4. Shade walls and paved areas adjacent to building to reduce indoor/outdoor temperature differential		0							2	1	3		1	2	3		0					
5. Reduce paved areas and use grass or other vegetation to reduce outdoor temperature buildup		0							2	1	3		1	2	3		0					
6. Use ponds, water fountains, to reduce ambient outdoor air temperature around building				0					2	1	3		1	3	2		0					
7. Collect rain water for use in building																						
8. Locate building on site to induce air flow effects for natural ventilation and cooling				0					2	1	3			0	2	3	1					
9. Locate buildings to minimize wind effects on exterior surfaces	2			1				3		0			0		3	2	1					
10. Select site with high air quality (least contaminated) to enhance natural ventilation				0					2	1	3			0	2	3	1					
11. Select a site which has year round ambient wet and dry bulb temperatures close to and somewhat lower than those desired within the occupied spaces																						
12. Select a site that has topographical features and adjacent structures that provide breaks	2			1				3			0			0	3	2	1					
13. Select a site that has topographical features and adjacent structures that provide desirable shading.	0					3			2	1			2	1		3	0					
14. Select site that allows optimum orientation and configuration to minimize yearly energy consumption																						
15. Select site to reduce specular heat reflections from water.				0		3			2	1			2	1		3	0					

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS					
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
																		4	3	2	1	0
16. Use sloping site to bury building partially or use earth berms to reduce heat transmission and solar radiation	2		3	1						0			1	2	3		0					
17. Select site that allows occupants to use public transport systems																						
BUILDING																						
1. Construct building with minimum exposed surface area to minimize heat transmission for a given enclosed volume	2		3	1						0			1	2	3		0					
2. Select building configuration to give minimum north wall to reduce heat losses	2		3	1						0												
3. Select building configuration to give minimum south wall to reduce cooling load													1	2	3		0					
4. Use building configuration and wall arrangement (horizontal and vertical sloping walls) to provide self shading and wind breaks	2			1				3			0		1	2	3							
5. Locate insulation for walls and roofs and floors over garages at the exterior surface.	3		2	1						0			1	2	3		0					
6. Construct exterior walls, roof and floors with high thermal mass with a goal of 100 pounds per cubic foot.	2		3	1							0		1	2	3		0					
7. Select insulation to give a composite U factor from 0.06 when outdoor winter design temperatures are less than 10 degrees F. to 0.15 when outdoor design conditions are above 40 degrees F																						
8. Select U factors from 0.06 where sol air temperatures are above 144 degrees F. up to a U volume of 0.3 with sol air temperatures below 85 degrees F																						
9. Provide vapor barrier on the interior surface of exterior walls and roof of sufficient impermeability to provide condensation																						
10. Use concrete slab on grade for ground floors	2		3	1						0			1	2	3		0					
11. Avoid cracks and joints in building construction to reduce infiltration	2		3	1									3	1		2						
12. Avoid thermal bridges through the exterior surfaces	2		3	1							0		2	1		3	0					
13. Provide textured finish to external surfaces to increase film coefficiency	2			1				3		0												

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS					
	sun 50% of daylight time or more wind 9 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 50% of daylight time or more wind 9 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 50% of daylight time or more wind 9 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 50% relative humidity or less	dry climate of 50% relative humidity or more	dry climate of 50% relative humidity or less	dry climate of 50% relative humidity or more		FULLY SATISFIED 4	MOSTLY SATISFIED 3	PARTIALLY SATISFIED 2	NOT SATISFIED 1	NOT APPLICABLE 0
14. Provide solar control for the walls and roof in the same areas where similar solar control is desirable for glazing	0	0	0	0									2	1		3						
15. Consider length and width aspects for rectangular buildings as well as other geometric forms in relationship to building height and interior and exterior floor areas to optimize energy conservation	2		3	1						0			1	2	3		0					
16. To minimize heat gain in summer due to solar radiation, finish walls and roofs with a light colored surface having a high emissivity													1	2	3							
17. To increase heat gain due to solar radiation on walls and roofs, use a dark colored finish having a high absorptivity	1	2		3						0												
18. Reduce heat transmissions through roof by one or more of the following items																						
a. Insulation	2		3	1							0		1	2	3		0					
b. Reflective surfaces				0					2	1	3		1	2	3							
c. Roof spray													1		2		3					
d. Roof pond													1		2		3					
e. Sod and planning	2		3	1						0			1	2	3		0					
f. Equipment and equipment rooms located on the roof	2		3	1									1	2	3							
g. Provide double roof and ventilate space between													1	2	3		0					
19. Increase roof heat gain when reduction of heat loss in winter exceeds heat gain increase in summer																						
a. Use dark colored surfaces	2	1			0	3																
b. Avoid shadows	2	1			0	3																
20. Insulate slab on grade with both vertical and horizontal perimeter insulation under slab	1	1	1	1	2	2	2	2	3	3	3	3										
21. Reduce infiltration quantities by one or more of the following measures																						
a. Reduce building height																						
b. Use impermeable exterior surface materials	2		3	1								0										
c. Reduce crackage area around doors, windows, etc., to a minimum													3	1		2	0					
d. Provide all external doors with weather stripping																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE DAYS OR MORE				HEATING SEASON OF 4,000 TO 6 000 DEGREE DAYS				HEATING SEASON OF 4,000 DEGREE DAYS OR LESS				COOLING SEASON MORE THAN 1 500 HRS AT 80°F		COOLING SEASON 600 TO 1 500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
e. Where operable windows are used, provide them with sealing gaskets and cam latches																						
f. Locate building entrances on downwind side and provide wind break																						
g. Provide all entrances with vestibules; where vestibules are not used, provide revolving doors																						
h. Provide vestibules with self closing weather stripped doors to isolate them from the stairwells and elevator shafts	2		3	1								0	3	1		2	0					
i. Seal all vertical shafts																						
j. Locate ventilation louvers on downwind side of building and provide wind breaks																						
k. Provide break at intermediate points of elevator shafts and stairwells for tall buildings																						
22. Provide wind protection by using fins, recesses, etc , for any exposed surface having a U value greater than 0 5	2			1				3		0												
23. Do not heat parking garages																						
24. Consider the amount of energy required for the protection of materials and their transport on a life cycle energy usage																						
25. Consider the use of the insulation type which can be most efficiently applied to optimize the thermal resistance of the wall or roof, for example some types of insulation are difficult to install without voids or shrinkage																						
26. Protect insulation from moisture originating outdoors, since volume decreases when wet Use insulation with low water absorption and one which dries out quickly and regains its original thermal performance after being wet																						
27. Where sloping roofs are used, face them to south for greatest heat gain benefit in the wintertime	1	2			3							0										
28. To reduce heat loss from windows consider one or more of the following																						
a. Use minimum ratio of window area to wall area																						
b. Use double glazing																						
c. Use triple glazing																						
d. Use double reflective glazing.				1				2				3										
e. Use minimum percentage of the double glazing on the north wall	1	1			2	2			3	3												

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS.					
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		FULLY SATISFIED 4	MOSTLY SATISFIED 3	PARTIALLY SATISFIED 2	NOT SATISFIED 1	NOT APPLICABLE 0
f. Manipulate east and west walls so that windows face south			1				2				3											
g. Allow direct sun on windows November through March																						
h. Avoid window frames that form a thermal bridge																						
i. Use operable thermal shutters which decrease the composite U value to 0.1																						
29. To reduce heat gains through windows, consider the following																						
a. Use minimum ratio of window area to wall area																						
b. Use double glazing																						
c. Use triple glazing													1		2		3					
d. Use double reflective glazing														1		2	3					
e. Use minimum percentage of double glazing on the south wall																						
f. Shade windows from direct sun April through October																						
30. To take advantage of natural daylight within the building and reduce electrical energy consumption, consider the following																						
a. Increase window size but do not exceed the point where yearly energy consumption, due to heat gains and losses exceeds the saving made by using natural light																						
b. Locate windows high in wall to increase reflection from ceiling, but reduce glare effect on occupants		3			2	2			1	1												
c. Control glare with translucent draperies operated by photo cells			3	3			2	2			1	1										
d. Provide exterior shades that eliminate direct sunlight, but reflect light into occupied spaces													3	3	2	2	1					
e. Slope vertical wall surfaces so that windows are self shading and walls below act as light reflectors																						
f. Use clear glazing. Reflective or heat absorbing films reduce the quantity of natural light transmitted through the window																						
31. To allow the use of natural light in cold zones where heat losses are high energy users, consider operable thermal barriers	2			1				3			0											
32. Use permanently sealed windows to reduce infiltration in climatic zones where this is a large energy user	1			2	3						0		1	2	3		0					

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6 000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4 000 TO 6 000 DEGREE-DAYS				HEATING SEASON OF 4 000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1 500 HRS AT 80°F		COOLING SEASON 600 TO 1 500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS					
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
																		4	3	2	1	0
33. Where codes of regulations require operable windows and infiltration is undesirable, use windows that close against a sealing gasket	1			2	3						0		1	2	3		0					
34. In climatic zones where outdoor air conditions are suitable for natural ventilation for a major part of the year, provide operable windows				0					3	1	2			0	2	3	1					
35. In climate zones where outdoor air conditions are close to desired indoor conditions for a major portion of the year, consider the following																						
a. Adjust building orientation and configuration to take advantage of prevailing winds																						
b. Use operable windows to control ingress and egress of air through the building																						
c. Adjust the configuration of the building to allow natural cross ventilation through occupied spaces														0	2	3	1					
d. Use stack effect in vertical shafts, stairwells, etc., to promote natural air flow through the building																						
PLANNING																						
1. Group services rooms as a buffer and locate at the north wall to reduce heat loss or the south wall to reduce heat gain, whichever is the greatest yearly energy user	2		3	1						0			1	2	3		0					
2. Use corridors as heat transfer buffers and locate against external walls	2		3	1						0			1	2	3		0					
3. Locate rooms with high process heat gain (computer rooms) against outside surfaces that have the highest exposure loss	2		3	1						0												
4. Landscaped open planning allows excess heat from interior spaces to transfer to perimeter spaces which have a heat loss																						
5. Rooms can be grouped in such a manner that the same ventilating air can be used more than once, by operating in cascade through spaces in decreasing order of priority, i.e. office corridor toilet																						
6. Reduced ceiling heights reduce the exposed surface area and the enclosed volume. They also increase illumination effectiveness																						
7. Increased density of occupants (less gross floor area per person) reduces the overall size of the building and yearly energy consumption per capita																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE DAYS OR MORE				HEATING SEASON OF 4,000 TO 6 000 DEGREE DAYS				HEATING SEASON OF 4,000 DEGREE DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1 500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS.	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
8. Spaces of similar function located adjacent to each other on the same floor reduce the use of elevators																						
9. Offices frequented by the general public located on the ground floor reduce elevator use																						
10. Equipment rooms located on the roof reduce unwanted heat gain and heat loss through the surface They can also allow more direct duct and pipe runs reducing power requirements			2	1				3		0			1	2	3							
11. Windows planned to make beneficial use of winter sunshine should be positioned to allow occupants the opportunity of moving out of the direct sun radiation																						
12. Deep ceiling voids allow the use of larger duct sizes with low pressure drop and reduce HVAC requirements																						
13. Processes that have temperature and humidity requirements different from normal physiological needs should be grouped together and served by one common system																						
14. Open planning allows more effective use of lighting fixtures The reduced area of partitioned walls decreases the light absorption																						
15. Judicious use of reflective surfaces such as sloping white ceilings can enhance the effect of natural lighting and increase the yearly energy saved																						
VENTILATION AND INFILTRATION																						
1. To minimize infiltration, balance mechanical ventilation so that supply air quantity equals or exceeds exhaust air quantity	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
2. Take credit for infiltration as part of the outdoor air requirements for the building occupants and reduce mechanical ventilation accordingly	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
3. Reduce C F M /occupant outdoor air requirements to the minimum considering the task they are performing, room volume and periods of occupancy	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
4. If odor removal requires more than 2,000 cubic feet per minute exhaust and a corresponding introduction of outdoor air, consider recirculating through activated carbon filter					2	2	2	2	1	1	1	1	1	1	2	2	3					
5. Where outdoor conditions are close to but less than indoor conditions for major periods of the year, and the air is clean and free from offensive odors, consider the use of natural ventilation when yearly energy trade offs with other systems are favorable		0							2	1	3			0	2	3	1					

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE DAYS OR LESS				COOLING SEASON MORE THAN 1 500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
6. Exchange heat between outdoor air, intake and exhaust air by using heat pipes, thermal wheels run around systems, etc	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
7. In areas subjected to high humidities, consider latent heat exchange in addition to sensible														1		2	3					
8. Provide selective ventilation as needed, i.e , 5 cubic feet per minute/occupant for general areas and increased volumes for areas of heavy smoking or odor control																						
9. Transfer air from "clean" areas to more contaminated areas (toilet rooms, heavy smoking areas) rather than supply fresh air to all areas regardless of function																						
10 Provide controls to shut down all air systems at night and weekends except when used for economizer cycle cooling	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
11. Reduce the energy required to heat or cool ventilation air from outdoor conditions to interior design conditions by considering the following																						
a Reduce indoor air temperature setting in winter and increase in summer.	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
b. Provide outdoor air direct to perimeter of exhaust hoods in kitchens laboratories etc Do not cool this air in summer or heat over 50 degrees F in winter	1	1	1	1	2	2	2	2	3	3	3	3	1	1	2	2	3					
HEATING, VENTILATION AND AIRCONDITIONING																						
1. Use outdoor air for sensible cooling whenever conditions permit and when recaptured heat cannot be stored																						
2. Use adiabatic saturation to reduce temperature of hot, dry air to extend the period of time when "free cooling" can be used													1		2		3					
3. In the summer when the outdoor air temperature at night is lower than indoor temperature, use full outdoor air ventilation to remove excess heat and precool structure													1		2		3					
4. In principle, select the air handling system which operates at the lowest possible air velocity and static pressure Consider high pressure systems only when other trade offs such as reduced building size are an overriding factor																						
5. To enhance the possibility of using waste heat from other systems, design air handling systems to circulate sufficient air to enable cooling loads to be met by a 60 degree F air supply temperature and heating loads to be met by a 90 degree F air temperature																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1 500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 3 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
6. Design HVAC systems so that the maximum possible proportion of heat gain to a space can be treated as an equipment load, not as a room load																						
7. Schedule air delivery so that exhaust from primary spaces (offices) can be used to heat or cool secondary spaces (corridors)																						
8. Exhaust air from center zone through the lighting fixtures and use this warmed exhaust air to heat perimeter zones																						
9. Design HVAC systems so that they do not heat and cool air simultaneously.																						
10. To reduce fan horsepower, consider the following																						
a. Design duct systems for low pressure loss																						
b. Use high efficiency fans																						
c. Use low pressure loss filters concommitant with contaminant removal																						
d. Use one common air coil for both heating and cooling																						
11. Reduce or eliminate air leakage from duct work.																						
12. Limit the use of re heat to a maximum of 10 percent of gross floor area and then only consider its use for areas that have atypical fluctuating internal loads, such as conference rooms.																						
13. Design chilled water systems to operate with as high a supply temperature as possible – suggested goal 50 degrees F. (This allows higher suction temperatures at the chiller with increased operating efficiency.)																						
14. Use modular pumps to give varying flows that can match varying loads																						
15. Select high efficiency pumps that match load Do not oversize																						
16 Design piping systems for low pressure loss and select routes and locate equipment to give shortest pipe runs																						
17. Adopt as large a temperature differential as possible for chilled water systems and hot water heating systems																						
18. Consider operating chillers in series to increase efficiency																						
19 Select chillers that can operate over a wide range of condensing temperatures and then consider the following																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE DAYS				HEATING SEASON OF 4,000 DEGREE DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
a. Use double bundle condensers to capture waste heat at high condensing temperatures and use directly for heating or store for later use																						
b. When waste heat cannot be either used directly or stored, then operate chiller at lowest condensing temperature compatible with ambient outdoor conditions																						
20. Consider chilled water storage systems to allow chillers to operate at night when condensing temperatures are lowest																						
21. Consider the use of double bundle evaporators so that chillers can be used as heat pumps to upgrade stored heat for use in unoccupied periods																						
22. Consider the use of gas or diesel engine drive for chillers and large items of ancilliary equipment and collect and use waste heat for absorption cooling, heating, and/or domestic hot water																						
23. Locate cooling towers or evaporative coolers so that induced air movement can be used to provide or supplement garage exhaust ventilation																						
24. Use modular boilers for heating and select units so that each module operates at optimum efficiency																						
25. Extract waste heat from boiler flue gas by extending surface coils or heat pipes																						
26. Select boilers that operate at the lowest practicable supply temperature while avoiding condensation within the furnaces																						
27. Use unitary water/air heat pumps that transport heat energy from zone to zone via a common hydronic loop																						
28. Consider the use of thermal storage in combination with unit heat pumps and a hydronic loop so that excess heat during the day can be captured and stored for use at night																						
29. Consider the use of heat pumps both water/air and air/air if a continuing source of low grade heat exists near the building, such as lake, river, etc																						
30. Consider the direct use of solar energy via a system of collectors for heating in winter and absorption cooling in summer																						
31. Minimize requirements for snow melting to those that are absolutely necessary and, where possible, use waste heat for this service																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE DAYS				HEATING SEASON OF 4,000 DEGREE DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
32. Provide all outside air dampers with accurate position indicators and insure that dampers are air tight when closed																						
33. If electric heating is contemplated, consider the use of heat pumps in place of direct resistance heating, by comparison they consume one third of the energy per unit output																						
34. Consider the use of spot heating and/or cooling in spaces having large volume and low occupancy																						
35. Use electric ignition in place of gas pilots for gas burners																						
36. Consider the use of a total energy system if the life cycle costs are favorable																						
LIGHTING AND POWER																						
1. a. Use natural illumination in areas where effective when a net energy conservation gain is possible vis a vis heating and cooling loads	3	3	3	3	2	2	2	2	1	1	1	1	3	3	2	2	1					
b. Provide exterior reflectors at windows for more effective internal illumination																						
2. Consider a selective lighting system in regard to the following																						
a. Reduce the wattage required for each specific task by review of user needs and method of providing illumination																						
b. Consider only the amount of illumination required for the specific task considering the duration and character and user performance required as per design criteria																						
c. Group similar task together for optimum conservation of energy per floor																						
d. Design switch circuits to permit turning off unused and unnecessary light																						
e Illuminate tasks with fixtures built into furniture and maintain low intensity lighting elsewhere																						
f. Consider the use of polarized lenses to improve quality of lighting at tasks																						
g. Provide timers to automatically turn off lights in remote or little used areas																						
h. Use multilevel ballasts to permit varying the lumen output for fixtures by adding or removing lamps when tasks are changed in location or requirements																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
1. Arrange electrical systems to accommodate relocatable luminaires which can be removed to suit changing furniture layouts																						
2. Consider the use of ballasts which can accommodate sodium metalhalide bulbs interchangeably with other lamps																						
3. Consider the use of high frequency lighting to reduce wattage per lumen output. Additional benefits are reduced ballast heat loss into the room and longer lamp life																						
4. Consider the use of landscape office planning to improve lighting efficiency. Approximately 25 percent less wattage per foot candles on task for open planning versus partitions																						
5. Consider the use of light colors for walls, floors and ceilings to increase reflectance but avoid specular reflections																						
6. Lower the ceilings or mounting height of luminaires to increase level of illumination with less wattage																						
7. Consider dry heat of light systems to improve lamp performance and reduce heat gain to space																						
8. Consider wet heat of light system to improve lamp performance and reduce heat gain to space and refrigeration load																						
9. Use fixtures that give high contrast rendition factor at task																						
10. Provide suggestions to GSA for analysis of tasks to increase use of high contrast material which requires less illumination																						
11. Select furniture and interior appointments that do not have glossy surfaces or give specular reflections																						
12. Use light spills from characteristic areas to illuminate non characteristic areas																						
13. Consider use of greater contrast between tasks and background lighting, such as 8 to 1 and 10 to 1																						
14. Consider washers and special illumination for features such as plants, murals, etc., in place of overhead space lighting to maintain proper contrast ratios																						
15. For horizontal tasks or duties, consider fixtures whose main light component is oblique and then locate for maximum ESI footcandles on task																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6,000 DEGREE DAYS OR MORE				HEATING SEASON OF 4,000 TO 6,000 DEGREE-DAYS				HEATING SEASON OF 4,000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1,500 HRS AT 80°F		COOLING SEASON 600 TO 1,500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS					
	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 9 miles/hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
																		4	3	2	1	0
16. Consider using 250 watt mercury vapor lamps and metal halide lamps in place of 500 watt incandescent lamps for special applications																						
17. Use lamps with higher lumens per watt input, such as																						
a. One 8 foot fluorescent lamp versus two 4 foot lamps																						
b. One 4 foot fluorescent lamp versus two 2 foot lamps																						
c. U tube lamps versus two individual lamps.																						
d. Fluorescent lamps in place of all incandescent lamps except for very close task lighting, such as at a typewriter paper holder																						
18 Use high utilization and maintenance factors in design calculations and instruct users to keep fixtures clean and change lamps earlier																						
19 Avoid decorative flood lighting and display lighting																						
20 Direct exterior security lighting at entrances and avoid illuminating large areas adjacent to building																						
21 Consider switches activated by intruder devices rather than permanently lit security lighting																						
22 If already available, use street lighting for security purposes																						
23 Reduce lighting requirements for hazards by																						
a. Using light fixtures close to and focused on hazard																						
b. Increasing contrast of hazard, i.e., paint stair treads and risers white with black nosing.																						
24 Consider the following methods of coping with code requirements																						
a. Obtaining variance from existing codes																						
b. Changing codes to just fulfill health and safety functions of lighting by varying the qualitative and quantitative requirements to specific application																						
25. Consider the use of a total energy system integrated with all other systems																						
26 Where steam is available, use turbine drive for large items of equipment																						

	WINTER												SUMMER					REQUIREMENT				
	HEATING SEASON OF 6 000 DEGREE-DAYS OR MORE				HEATING SEASON OF 4 000 TO 6 000 DEGREE DAYS				HEATING SEASON OF 4 000 DEGREE-DAYS OR LESS				COOLING SEASON MORE THAN 1 500 HRS AT 80°F		COOLING SEASON 600 TO 1 500 HRS AT 80°F		COOLING SEASON LESS THAN 600 HRS	FULLY SATISFIED	MOSTLY SATISFIED	PARTIALLY SATISFIED	NOT SATISFIED	NOT APPLICABLE
	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	sun 60% of daylight time or more wind 3 miles hr or more	sun condition no wind condition	no sun condition wind condition	no sun condition no wind condition	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more	dry climate of 60% relative humidity or less	dry climate of 60% relative humidity or more		4	3	2	1	0
27. Use heat pumps in place of electric resistance heating and take advantage of the favorable coefficient of performance																						
28. Match motor sizes to equipment shaft power requirements and select to operate at the most efficient point																						
29. Maintain power factor as close to unity as possible																						
30. Minimize power losses in distribution system by																						
a. Reducing length of cable runs																						
b. Increasing conductor size within limits indicated by life cycle costing																						
c. Use high voltage distribution within the building																						
31. Match characteristics of electric motors to the characteristics of the driven machine																						
32. Design and select machinery to start in an unloaded condition to reduce starting torque requirements. (For example, start pumps against closed valves.)																						
33. Use direct drive whenever possible to eliminate drive train losses																						
34. Use high efficiency transformers (these are good candidates for life cycle costing)																						
35. Use liquid cooled transformers and captive waste heat for beneficial use in other systems																						
36. In canteen kitchens, use gas for cooking rather than electricity																						
37. Use conventional ovens rather than self cleaning type																						

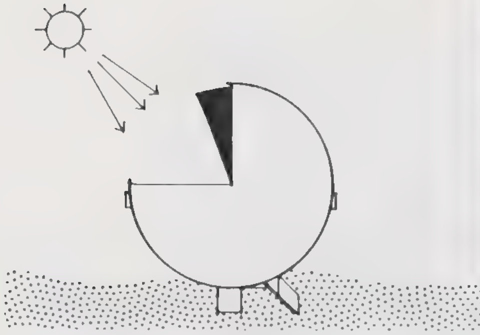
Author's design of Experimental House for the High Arctic.
(University of Toronto, 1968).

In extreme environments, energy was always a design constraint. In such situations it is possible to design, to experiment, and to experience the advantages of energy saving design features.

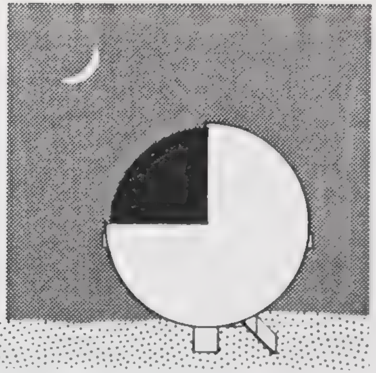
The sphere was chosen for the following reasons;

- Best volume/surface ratio efficiency
- Excellent aerodynamical properties
- Minimal transfer of heat to permafrost
- Could be constructed from identical elements (panels)

Furthermore, one quarter of the sphere opens in the arctic day (summer) and closes during the arctic night (winter). This "convertible" arrangement amplifies passive utilization of sun rays and efficiently prevents heat losses.

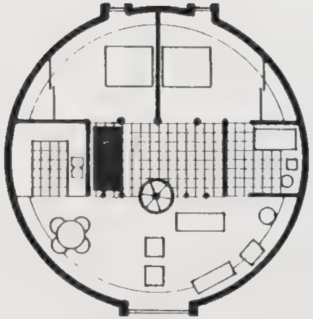


ARCTIC DAY

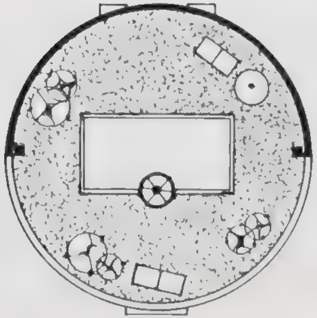


ARCTIC NIGHT

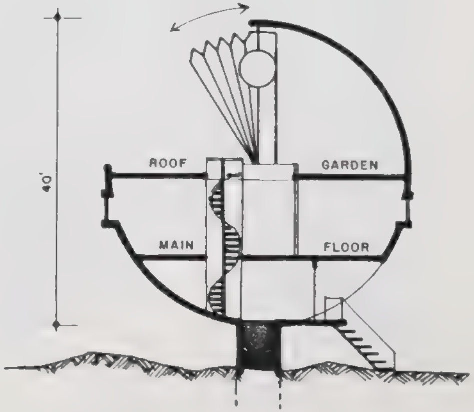
ARCTIC HOUSE



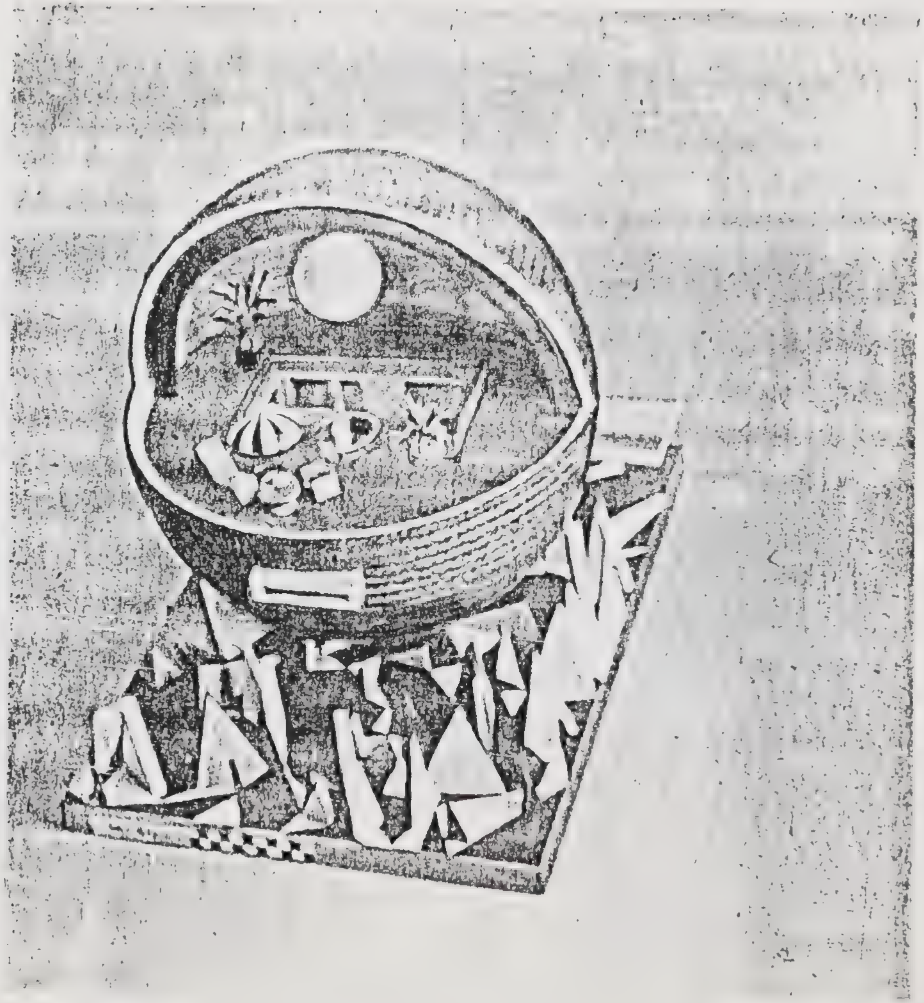
MAIN FLOOR



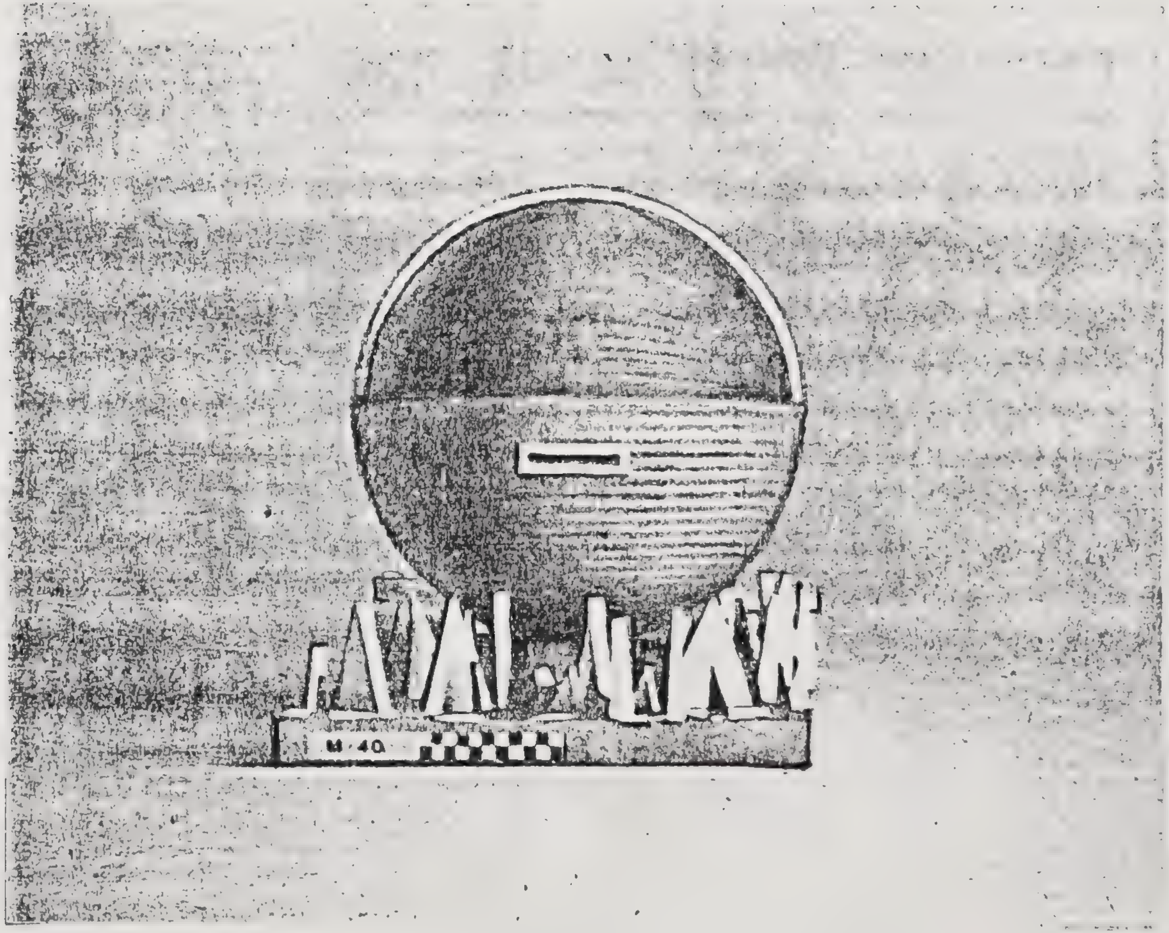
ROOF GARDEN



SECTION



"CONVERTIBLE" ARCTIC HOUSE — OPENED



"CONVERTIBLE" ARCTIC HOUSE – CLOSED

APPENDIX "E"

SELECTED ARTICLES

11 50. medium 10 00 10 50 tives

Utilities experiment with new off switch

NEW YORK (AP) — U.S utilities are starting to experiment with an automated system to turn off home and office air conditioners by remote control to reduce power loads and avoid blackouts

"Eventually, all utilities will be going to some sort of automation like this," predicted Jeff Serfass of the U.S. Energy Research and Development Agency.

With serious questions arising about the reliability of electricity during the next 10 years, many utilities are searching for new methods of "load management." Building new generators is expensive and time consuming, so finding ways to reduce or restructure power usage is attractive to electric companies

Basically, the utility installs a cut-off device on the air conditioner or water heater and then activates it via radio or other transmissions.

"We're able to clip the peak off our peak load," said Pete Rice, a spokesman for Arkansas Power and Light Co. of Little Rock. "It also saves money in future generating capacity and we don't have to run more expensive equipment now."

John Hamann, president of Detroit Edison Co., said: "We have found that not only does this (remote control) help reduce investment in generating plants by shaving peaks, but also, by shifting load to off-peak hours, we can reduce fuel costs as well. The millions of dollars invested in radio equipment were more than offset by the millions that were not spent on adding generating plants."

Some systems not only can shut off air conditioners and water heaters, but can also automatically read power meters and keep track of electricity consumption under more than one rate plan.

Oct 15·77 G&M

Awareness of energy is urged in housing

By JACK WILLOUGHBY
Globe and Mail Reporter

HAMILTON — The high cost of energy could undermine the affordability of housing if new energy-efficient designs are not introduced by builders, says Malcolm Rowan, deputy minister of the Ontario Ministry of Energy.

He told builders attending the annual meeting of the Ontario council of the Housing and Urban Development Association of Canada that energy costs are taking an increasing share of the family budget and will continue to do in future years.

"What is needed to counter the cost-affordability dilemma are new building designs that recognize the imperative of energy costs," he said

Canadians have not yet accepted the type of urban lifestyle of some European countries where a greater population density allows energy saving. He added that the Canadian dream of a detached home in the country is not realistic in today's energy situation.

Mr. Rowan said discussions between governments, business and the public is needed but that this has been preempted by the introduction of the Canadian Home Insulation Program by the federal Government.

Before the provinces were allowed to participate in CHIP, they were required to adopt the requirements for energy conservation that are set out in the national code expected to be effective early next year.

Debate over the requirements of the proposed code is continuing, but Mr. Rowan said there are some areas that are not applicable to Ontario. He assured the builders that the Ontario Ministry of Consumer and Commercial Relations would not incorporate any changes in the building code without consulting the industry

GLOBE AND MAIL, SATURDAY, MARCH 26, 1977 15

Canada seen getting 40% of a home's heat from sun in future

By JOAN HOLLOBON
Globe and Mail Reporter

OTTAWA — Solar heating will be a billion-dollar industry, possibly within 10 to 15 years, a National Research Council engineer predicted yesterday.

Dr. Philip Cockshutt said that eventually the most likely method of harnessing the sun's rays to heat Canadian homes will be to have a central installation to collect, store and distribute the heat. He said that centrally stored heat, usually in the form of hot water, is distributed as far as 60 kilometres in the Soviet Union.

Dr. Cockshutt told the annual seminar of the Canadian Science Writers Association, that the NRC has 14 demonstration projects now from coast to coast, mainly single-family dwellings. The next stage will be multi-family residences, such as low-rise apartments or row housing. Solar heating may be more economical when the considerable outlay can be used for a number of residences.

Dr. Cockshutt said solar heat can cut conventional heating requirements by as much as 40 per cent.

Dr. Cockshutt, co-ordinator of the NRC's energy project, said that the 14 demonstration homes using a variety of technical processes cost $230,000. Solar equipment in each cost $15 000, including monitoring equipment. Without this, the equipment would cost from $7,000 to $10,000 for a house where 40 per cent of heat would be drawn from the sun.

Studies show that Canada has enough sunshine to make solar heating a practical source of energy. The first requirement is to overcome technical problems, because the needs of this country, based on climate, differ from those of the United States, Australia or Israel.

Dr. Cockshutt said cost and durability must be first priorities in research and development. Extensive use of solar heating will be slow, because houses are not rapidly replaced.

He said that Canadians live "high on the hog," when it comes to energy, using the equivalent of 10 kilowatts continuously for every man, woman, and child in the country, compared with 4 kilowatts per capita in Sweden.

Dr. Cockshutt said that for 1977-78 Canada has increased its energy research and development budget from about $127-million to $137-million.

The budget for research into renewable energy sources (such as solar heat) will go up this year to $9.1-million from $4.7-million last year.

However, Canada is allocating nothing for basic science research support in the energy field, where the United States has set aside $290-million for this in a total energy research budget of $2.5-billion, 20 times the Canadian budget.

MARCH 23RD 77 G+M

Hydro

I wonder when all of us besieged consumers are going to have the opportunity of a say in the pricing of some of our utilities.

This week I was appalled to receive my current Hydro invoice in the gross amount of $94.83. Allowing for the 10 per cent discount for prompt payment, this bill is $23.56 more than the January bill and practically 100 per cent more than the same period of last year. My discounted bills for 1976 to date are as follows:

January, 1976	$38.01
March	44.90
May	46.71
July	41.85
September	55.09
November	55.09
January, 1977	61.63
March	85.39

It is perfectly evident that a healthy increase has taken place. We were, of course, warned of the rise in the cost of energy and were somewhat resignedly prepared when the regulating body (as usual) granted rate increases, but this much in one year appears to be excessive. This is especially galling considering the Hydro campaign for years to con people into buying more and more electrical appliances with the adage "to live cheaper and better electrically."

Gwendolyne Green
Toronto

JAN 1ST:77

Solar heating held as efficient as electricity

WASHINGTON (DJ) — Solar heating can compete economically with electric heating in well insulated new homes, a U.S. Government study shows.

The study, supported by the Energy Research and Development Administration, defines a solar system as economically competitive if within five years the bill for another form of heating is greater than the annual payment on the solar system.

The study assumes a 10 per cent annual increase in the cost of all other energy sources. According to the study, within three years the principal and interest on most solar systems would be less than the electricity bill.

The average solar system costs about $20 a square foot, ERDA officials say. That means the average cost of a solar system for a single-family home is between $6,000 and $9,000.

NOV. 16. 76

Solar energy

Y+M

We were disappointed that you only consulted the Ontario Hydro study (Solar Heating Hope Overshadowed by Cost—Oct. 30) in reporting on the state of solar heating technology. While Hydro's study was, undoubtedly, technical, the assumptions used and figures arrived at are debatable.

The engineering of a solar heating system entails three major factors: floor space to be heated, solar panel area and storage volume. In the article, Hydro's parameters are not all given. Reference to their study of December, 1975, An Examination of the Potential for Solar Energy Utilization in Ontario, reveals that for a 70 per cent solar heating system they use 1,800 square feet of floor space, 1,080 square feet of solar panels, and 2,000 gallons of water storage. Other studies use different variables, particularly for storage. The costs vary with the parameters.

The Lorriman house in Mississauga has 1,500 square feet of floor space, 700 square feet of solar panels, and 5,000 gallons of water storage. This provides a 70 per cent solar heating system.

A Colorado State University solar heated house has 1,500 square feet of floor space, 750 square feet of solar panels and 1,131 gallons of water storage. This is a 75 per cent solar heating system. The house requires a smaller storage volume because the mean daily solar radiation is higher than in Ontario. Nevertheless, the Hydro figure of 20,000 gallons appears excessive

Ontario Hydro claims that when solar heated rooms are in need of back-up energy they will demand peak period electricity. They do not state that solar heated homes could be backed up alternatively by oil or gas, nor do they mention the possibility of using off-peak power to heat the storage unit. Solar heated homes, of course, store the sun's energy for use on cloudy days; current systems are efficient for three consecutive days without sun.

The social and environmental costs of energy systems other than the sun must be noted. Ontario Hydro was quoted in the Energy Strategy for Canada as stating that 57 per cent of electricity generation in Ontario will come from nuclear reactors by 1990. The debate over this energy source need not be discussed here. Also, the mass implementation of solar heating will result in several million barrels of oil saved per year.

The Ontario Hydro study unfairly compares the cost of a prototype solar heating system with an established technology. When solar panels become mass produced, scale economies will likely result in reduced costs.

Problems will certainly arise in the early stages of solar heating implementation. But the need for safe and clean sources of energy is shared by all Canadians. Solar heating will ultimately help to ease the energy crisis in Canada, and with support from all involved groups and governments, production will begin sooner rather than later.

Dr. M. K. Berkowitz (and three others)
Institute of Policy Analysis
University of Toronto

Solar Heating Hope Overshadowed by Cost (Oct. 29) demonstrates a lack of understanding of the nature of current solar heating technology and, in its pessimistic conclusions, perpetuates a number of widely held misperceptions regarding the potential of solar heating in Ontario.

The Ontario Hydro report, upon which this article appears largely to be based, is inadequate in several important respects. For example, the size of the solar heat storage tank assumed in the Hydro study is about 10 times larger, and hence more expensive, than that which would be required in an optimally designed solar heating system. Moreover, existing solar collector technology, such as in operation at a Consumers' Gas installation in Toronto, is substantially more efficient in capturing solar energy than that assumed in the Hydro study. Consequently, a considerably smaller collector would be required in a house employing current solar collector technology as compared to the Hydro study, with a resulting reduction in initial costs.

When these two factors are taken into account, recent studies have shown that in the near future, when economies-of-scale of mass production of collectors can be expected, the life-cycle cost of a solar space heating system becomes competitive with conventional heating systems.

Ontario is at a major crossroads in its use of energy. In the years ahead, as our traditional resources of cheap and readily available fossil fuels dry up and the pinch of being, in an energy sense, a "have-not" province is felt, Ontario may urgently require new sources of indigenous energy. Informed public discussion on all the energy options open to the province, including solar energy, is essential. Your article can serve only to confuse and impede this discussion.

R. Macdonald, Assistant Professor
Faculty of Environmental Studies
York University, Downsview
Dan Shatil
Solar Energy Society of Canada
(Ontario Chapter)
Toronto

JAN. 15. 77 (G+T)

Energy tub-thumping

A tremendous waste of energy occurs during cold weather when hot water is allowed to run down the drains after it has been used for bathing, dish washing, laundry etc. If left in the building until it cooled, all the heat would be retained indoors, thus reducing the need for oil, gas or electric heating.

A simple solution would be to install a holding tank in each basement that would radiate the heat from warm waste water into the air. The tank would be emptied by a valve, operated manually or by a thermostat, when the water had cooled to air temperature. It would need an overflow pipe direct to the main drain, and during hot weather the water would flow straight through. A 100- or even a 50-gallon tank would probably be ample for most single-family dwellings.

John E. Ricketts
Uxbridge

THE GLOBE AND MAIL, THURSDAY, APRIL 28, 1977 — E 4

Crisis within 10 years forecast for energy unless decisions made

Canada could face an energy supply crisis within 10 years unless it deals quickly and decisively with the situation, according to Energy Minister Alastair Gillespie.

"We have not yet faced an energy supply crisis in Canada. But we could face one within a decade unless we respond wisely, quickly and decisively. We are better off than almost every industrial nation. But we have to reconcile ourselves to the fact that the development of our resources is going to cost significantly more than in the recent past," he told the annual meeting of the Retail Council of Canada in Toronto.

His message was clear: Canada's resources are getting smaller, demand continues to grow, and prices for oil must go up. Mr. Gillespie also stressed the need for conservation measures—and made his point by distributing copies of his speech typewritten on the backs of old geological maps of Canada.

"We estimate that by 1985, unles we are able to change present trends, we will require net imports of oil to meet betwen 40 and 50 per cent of our domestic requirements.

"This would result in a deficit in our oil trade in current prices of some $4.5-billion. but of even greater concern is our political vulnerability, our national security, as these foreign resources are placed under increasing pressure by steadily growing world demand."

The potential resources in Canada—the Athabasca oil sands and the heavy oil deposits of Western Canada—are indeed great, but "the vast bulk of these reserves remain beyond our grasp because we lack the technology to extract them or because of the high costs of extraction under current technology."

Canada's energy policy has two main prongs, Mr. Gillespie said, one aimed at moderating the growth of demand and the other at increasing the supply of energy.

Energy consumption in Canada has grown at an annual average rate of 5.4 per cent. "Our target is to reduce that rate of growth to less than 3.5 per cent by 1985."

It is possible for industry to reduce consumption per unit of output by an average of 13 per cent by 1985 and by 50 per cent during the next 25 years, he said. "I believe this can and must be done because industry in this country currently uses 50 per cent more energy in its production than its competitors in Europe."

Consumers, too, must play a part in conservation. Next year, the Department of Consumer and Corporate Affairs will require the attachment of energy-use labels on all major home appliances. And car manufacturers have agreed to put government-rated gasoline mileage stickers on all 1977 model cars.

Mr. Gillespie warned that domestic oil prices must increase toward international oil prices. While prices that reflect the real supply and demand situation will be much higher, the increased revenues and profits will in turn aid exploration and development of new resources.

JAN. 8th 77 Y+M

Swedes lead way in energy conservation

© New York Times Service

NEW YORK — The people of Sweden, who live about as well materially as average North Americans, consume a lot less energy in pursuit of the good life.

Attention to the Swedish success in using energy at only 60 per cent of the North American rate has intensified this year among conservationists and other energy analysts.

Earlier attempts to compare North American energy use with that of Western Europe were dismissed as too sketchy or as neglecting differences in population densities and industrial patterns. But Sweden has a standard of living, industrial mix and population distribution closely comparable to the United States.

In the past two years, three comparative studies have been made. The most detailed and most recent of these is by Lee Schipper and Allan Lichtenberg of the Energy and Resources Group of the University of California at Berkeley.

In an interview, Dr. Lichtenberg elaborated on the report, whose comparisons chiefly involve data from 1971, before the 1973 oil crisis intensified pressures for conservation.

Reviewing a mass of U.S. and Swedish published information, the California researchers found that the Swedes achieved their energy savings in many sectors of the economy, most dramatically in transportation.

The average weight of automobiles in Sweden was only 2,400 pounds, compared with the U.S. figure of 3,700. Apparently because of reliance on better mass transit, there were only 0.3 cars per person in Sweden, compared with 0.45.

In Sweden, where "second cars are replaced by mass transit and a significant number of families have no car at all," people used their long-lived cars (14 years versus less than 10 in the United States) for only 55 per cent of their trips shorter than six miles, compared with 90 per cent in the United States."

Swedes tend to use their cars mainly for recreation, relying on mass transit for shopping and commuting.

Stiff taxes on gasoline and the actual weight of cars exert pressure for low-maintenance, high-efficiency, low-weight cars. Sales taxes were about $500 for a 2,500-pound car and rose to $900 for the average U.S. weight. Annual user charges began at $32 for the 2,400-pound car and increased $8.40 for each additional 220 pounds.

The U.S. transportation sector used about 24,000 out of a total budget of 100,000 kilowatt-hours of heat per person. In Sweden, transportation required 7,800 kilowatt-hours out of a total of 60,000

In 1971, the United States burned 17 kilowatt-hours of heat for each 1972 dollar of economic output. Sweden consumed 10.

Homes halve heating costs

EDMONTON (CP) — Homes said to cut energy costs in half are being marketed for $35,000 by an Edmonton builder.

Spectrum Homes say the low energy houses will cost only half as much to heat as conventional homes because of more effective insulation.

The secret of the low energy homes is R 20 insulation in the walls and R 30 in the ceilings, manager Duncan McDonald said.

The $35,000 price tag for one of the 1,200-square-foot homes does not include land price, but does include cupboards, carpets, drapes, plumbing and two appliances.

McDonald said some of the houses are almost completed in the south end of the city.

"For another $10,000 or thereabouts we can install a solar energy system which will cut heating costs to a quarter of those in conventional homes," he said.

The company also is promoting triple glazing, which would give added insulation, but few people are buying it because of the added cost.

Another advantage of the low energy homes is that the added insulation makes them cool in the summer, McDonald said.

NOV. 2. 76 G+M

To seal the energy leaks

The people of California, incidental to the elections today, will vote on a proposal to provide $25-million in state funds for insulation of residential property and installation of solar heating and cooling systems. A seed project to promote the conservation of energy.

In California they will be more concerned with the energy waste by air-conditioners than by furnaces; but at least they are concerned. In Canada, where we could well be troubled with the problem of not freezing to death, one would expect the level of concern to be much higher. And where is it? At an alarmingly low level, Charles Smith, assistant deputy minister of the federal Department of Energy, has suggested to the Canadian Building Congress.

The Canadian Building Code is a safety document; it deals with health, structural and fire safety. A Canadian code for residential construction, which must be followed for all construction under the National Housing Act, does require insulation. But that leaves commercial buildings uncovered. A draft of new energy standards for all buildings has been prepared by an interdepartmental committee and will be considered today at a meeting of representatives from across Canada of all groups involved in building—architects, engineers, owners, operators, academics. It is hoped that what will emerge is a new energy standards code to be attached as a supplement to the National Building Code.

But the National Building Code, with or without energy supplement, is only a model document. It has no status until it is adopted by a province or a municipality.

"One of the principal facets of energy conservation in buildings is a proper building code with realistic energy standards," said Mr. Smith. "Some provinces have implemented building codes with energy requirements, and Ontario is clearly in the lead in this respect. In fact, the Ontario Government is *the* leader among provincial governments in implementing energy conservation policies and programs. It is a matter of alarm, however, that some provinces still lack building codes and most lack energy standards for buildings."

It is, of course, the provinces' constitutional right not to have building or energy standards. This has led to a lot of substandard, uninsulated buildings and, now, to a real threat that some Canadians will be actually cold.

Ottawa has not been hesitant to invade the provincial jurisdiction on a number of other matters. Perhaps if all of the provinces have not adopted a national energy code for buildings by, say, the end of next year, Ottawa should consider an invasion that would really do the people some good.

Belleville Intell. Dec 9. 77

Living

Underground—energy saver

EDWARDSVILLE, Ill. (AP) — The soil means more to Gary Davis than the place where his food grows. It's his home.

"Everything in this house saves energy," says Mr. Davis of his 4,068-square-foot dwelling located mostly underground near this southern Illinois community.

Mr. Davis who owns U'Bahn Earth Homes, Inc., estimates he will spend only about $375 a year to heat and cool the house.

He said underground homes maintain a year-round temperature of about 56 degrees Fahrenheit "So all we have to do is make up the difference."

He said he uses a device called an economizer, which pulls in clean, fresh air heated by the sun in the winter daytime. "The air will warm up the walls, the floors, everything. And when it shuts off, it recirculates the warm air. In the summer, we'll reverse it and turn on the economizer at night so the cool air can be brought in."

The desired temperature can be maintained for at least 12 hours, he said.

Mr. Davis also has a fireplace which he says can heat the whole house. Light enters the house through a large glass dome in the centre, over the indoor swimming pool.

"We found out through light readings that we have 20 per cent more light in our bedrooms than did 10 conventional homes," he said. "A full moon brings a lot of light in, too."

He estimates that a $100,000 conventional home could be built underground for about $80,000. The cost for an underground dwelling is $32 to $33 per square foot, without luxuries such as the pool.

Burglars would have a hard time with the Davis home, he said, because of its few windows and doors. The only windows to the outside are on the front of the house, but they are rounded domes of strong transparent plastic.

The front door has an air lock leading to a vestibule and another door. There is a door into the garage, but a special security device is on watch there.

The third door, an exit to the roof, cannot be opened from the outside.

Mr. Davis said he can save a lot of money on maintenance because there is no siding to paint or roof to replace.

The concrete roof is covered with two feet of soil and sod. "All I have to do is mow the grass."

Solar devices held ready to meet half the heating needs of a home

By JAMES RUSK

At the current state of the art, solar heating can probably save about half the fuel required by a home, according to Lynn Dudley, chairman of the Canadian Gas Association.

Mr. Dudley, who is president of Raypak Thermonics (Canada) Ltd. of Toronto, comes to the chairmanship of the CGA from the manufacturers' side of the industry.

Raypak is a major producer of oil or gas-fired boilers for industrial or commercial use, hot water heaters for industrial or commercial purposes, swimming pool heaters, and the largest producer of solar heating equipment in Canada.

And in his business, just as it is throughout the energy field, the emphasis today is on conservation. On a voluntary basis, the manufacturers' section of the association has been looking to higher standards for equipment, but in many countries, gas authorities are insisting on higher standards.

"It's going to be pretty rough on some equipment. With atmospheric boilers without a power burner, there is only a certain efficiency you can possibly achieve. Most manufacturers have reached that."

Raypak is now engaged in a design program with the Canadian Gas Research Institute to achieve higher efficiency.

But the need to conserve does not end with marginal improvement of the efficiency of equipment that uses hydrocarbon fuels, important as that may be.

Mr. Dudley said a fuel such as natural gas with its unique clean-burning properties should not be used in many situations where there is an alternative. In the case of swimming pools, solar heating is an alternative and solar heating for pools is one of the most rapidly growing markets the company has.

In the case of heating a house or its water supply, solar heating is a "fait accompli" in the southern regions of the United States with their much warmer ambient temperatures and long hours of sunlight, he said.

In Canada, solar heating is an assist and can replace about half the fuel.

He feels that, in the future, solar heating could become more important as economies of scale bring the costs of heating units down.

He is also working on what could be a next step in the changing technology of heating. He has a contract with the Canadian Gas Research Institute for work on a solar assisted heat pump, in which the refrigerant in the heat pump is pumped through a solar heating panel.

Preliminary work indicates that this design greatly increases the efficiency of the pump.

Mr. Dudley said the association which he now comes to head is unique. It represents all members of the gas industry from transmission companies and producers to utilities and manufacturers of gas equipment

Its functions go beyond the usual work of representing member interests to governments to the testing of gas equipment and the setting of equipment standards for the industry.

"I'm a strong believer in doing it first before the Government tells you to."

But there must be standards for the industry to follow, he added. "If I have to put an expensive valve on equipment for safety, I know everyone is equal."

And the manufacturers can assist in the fuel conservation effort by setting standards, such as requiring electrical starters for the burner on gas stoves rather than pilot lights, which everyone in the industry must meet, he added.

The manufacturers' section of the association must also work closely with the CGA's sister group, the Canadian Gas Research Institute, which is structured to conduct research of benefit to everyone in the industry, as well as special projects for companies that ask its help.

The association has done what Mr. Dudley feels is an excellent job on the continuing dialogue between government and the gas industry, which he wishes to keep going.

He also feels it can play a role in keeping consumers fully informed of events in the gas industry.

Spec May 8/77

Solar heat is now feasible

WATERLOO, Ont. (CP) — A report of a two-year study by solar energy researchers at University of Waterloo says widespread use of solar heating in Canada has become economically feasible.

Dr. Terry Hollands, mechanical engineering professor and senior researcher, and James Orgill, project engineer, conducted their study at the request of the National Research Council and with federal government funding. Among their conclusions:

- Solar heating should work equally well in urban centres across Canada, despite varying climatic conditions.
- The most promising type of building for solar heating is the "multiplex" dwelling — a town house or small apartment block, because solar energy can take care of residential hot-water needs.
- A 50-50 split between solar and conventional heating for multiplex dwellings would be cost-effective now, particularly if the backup system relied on oil. It would be even more so by 1980, when Canada will be paying world prices for oil.
- A similar 50-50 split was found to be cost-effective compared with 100 per cent electrical heating in Ontario and New Brunswick.

The team's findings were based on mathematical equations reflecting the operation of solar heating systems which were fed into a computer along with meteorological data from seven Canadian cities.

The team's economic valuation examined various types of collectors including liquid and air systems of various storage capacities, maintenance costs, how long the systems would function before needing replacement, the effect of interest rates on money borrowed to install them and future costs of conventional fuels.

The researchers based their mortgage calculations on interest rates of nine and 11.5 per cent.

Hollands said the most important factor is the future price of oil.

"If oil prices continue to increase faster than the cost of living and if you could get low-cost financing, say at nine per cent, for installing a 50-50 system with oil for the backup, then it would appear that it is cost-effective today to install solar heating, particularly if you are building a row house or some other multiplex type of building.

"Even if oil prices after 1980 don't go up any faster than the cost of living, solar heating is still interesting if you are thinking of a 35-65 arrangement, a system that handles about 35 per cent of your heating needs — again provided you could get nine per cent money."

Even at 11.5 per cent interest rates and with oil prices staying low, the researchers said, solar heating would be only about 20 per cent more costly than heating entirely with oil.

Governments concerned with conserving petroleum resources should consider concessions in the borrowing rate for builders of solar installations, the researchers said.

Power commissions pay about nine per cent to borrow money for new nuclear or coal-fired generating stations while private citizens pay about 11.5 per cent for mortgage money. If the latter rate were reduced, there would be more solar homes and less need for additional power stations.

15 years to change energy use, probe told

NOV. 20 · 78 G+M

By MICHAEL MOORE

Ontario has only about 15 years to set a pattern of saving or wasting energy that will carry well into the next century, a royal commission has been told.

Kirk Foley, president of the Urban Transportation Development Corp., told the Porter royal commission on electric power planning that population projections point to a housing boom for the next 15 years, followed by little new housing construction for almost a generation.

"City design can change only through growth," he said, and when the forthcoming boom is over there will be little growth within the foreseeable planning future.

Mr. Foley said there should be a strong commitment by governments to urban design that conserves energy.

He said such design must include decentralized commerce, higher residential densities in the suburbs and a high level of public transit.

The alternative, Mr. Foley said, is low-density urban sprawl, heavy dependence on the car for commuting, and continuing travel by the vast majority of commuters to the metropolitan core. All these alternatives waste energy.

Although Mr. Foley appeared before the Porter commission in his role as a seller of new street cars and a planned intermediate system between street cars and subways, he said studies by his corporation have shown transit planning must be related to the planning of housing.

Compact development supports good transit, he told the commission, transit is the best way to get around a densely built community, and the two together "provide an energy-efficient alternative urban form."

The children of the late 1950s and early 1960s, who filled the schools a decade ago and contribute to the unemployment problem now, will be out buying houses in the next 15 years, Mr. Foley said.

That will place "unprecedented demands on housing and municipal services," requiring "a dramatic increase in public investment."

After this boom in housing and services for housing, there will be a lull extending beyond the turn of the century, he said.

By comparison, major transit plans for Toronto, Ottawa and Hamilton are geared to the next 25 to 30 years, Mr. Foley said. He called for "a crash program within the next 15 years" to provide transit that will let urban planners follow their current inclination to more compact development.

Such a crash program, he said, would not do away with the car, but it could increase the share of daily urban trips that are taken by public transit from the present 25 per cent to 45 per cent by 1990.

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GM pushing solar studies in Woodstock

g+m

General Motors of Canada Ltd., Oshawa, is pushing ahead with studies on using solar energy to heat its new one-million-square-foot parts distribution warehouse in Woodstock.

An experimental pilot project undertaken last year using a small solar furnace has shown that heating the building by solar energy is feasible, said GM spokesman Nicholas Hall.

A plant engineering team is studying the data obtained from the experiments carried out on the huge flat-roofed structure. An analysis of the data is being made to establish the costs of converting to solar energy.

"The project is certainly under way and it looks like something we will be doing in the future, but I don't know when in the future," Mr. Hall said.

Reinforcing of the roof may be required, he said. Earlier this year, part of the roof collapsed when some steel welding trusses gave way.

The use of solar energy is part of a conservation program by GM Canada and its U.S. parent for plant heating where feasible.

Mr. Hall said designing of panels for solar beating has been turned over to GM's radiator division in Harrison, Ind., where the panels are being produced.

Tougher times ahead for Canadians

Energy crisis to force changes, report warns

By JOHN MARSHALL
Globe and Mail Reporter

OTTAWA — Canadian industrialists should look at their own shortcomings and ways to improve them before worrying about how they can be hurt by Canadian Science Council proposals that would radically change Canadian society, Dr. Ursula Franklin said yesterday.

A metallurgist at the University of Toronto and chairman of a special Science Council committee on conserver society studies, she was reacting to press conference questions about how some of her committee's proposals could raise production prices and make it tough for Canada in global markets.

One of the basic themes to a conserver society is finding ways to add to the price of any product its external costs to society — in pollution, waste disposal, early obsolescence and use of scarce resources. Other proposals would penalize some kinds of packaging, insist on more factual advertising.

Another member of her committee, Ran Ide, chairman of the Ontario Educational Communications Authority, said Canadians have been neglecting technological developments to the detriment of Canada's competitive position in some industries.

"I think it has worsened rather tragically over the last year," he told the conference at which the committee's wide-ranging report was officially released.

Speaking specifically of the mining-smelting industry, one of Canada's exporting backbones, Dr. Franklin said it should use the best of modern technology "rather than feel second best is good enough."

As an example, she said that in Canada the smelting industry is allowing foremen to make off-the-cuff decisions that are handled by computers in Japan.

Earlier she had mentioned that Japan used exact computerized techniques for metallurgical work, for deciding temperatures, mixes and exact times to pour castings. "Whereas two years ago at Noranda Mines an experienced foreman would say, 'Now!' "

Asked if that was still the method used, she said some of her students are involved in developing computer methods, "but they're also training foremen."

She and Science Council chairman Josef Kates put special emphasis on reassuring the public through the media that a switch from a consumer-oriented to a conserver-oriented society would not necessarily mean bureaucrats taking over the system or a no-growth economy.

"I, personally, want less bureaucracy," said Mr. Kates, a Toronto business consultant. "We don't want more government . . . what we're really looking for is more leadership."

The report — which calls for extensive long-range government planning, a stress on renewable energy resources, and a system of working out the total cost of a product, including its impact on the environment and whether it can be recycled — said at one point people were ready for change but that governments were slow in reacting.

Mr. Kates and Dr. Franklin both were critical of the Government of Ontario (though they implied that other governments were also at fault) for not giving sufficient cash support to ways of reducing private automobile use.

If just one per cent of the funds used on provincial highway projects were used for such things as parking facilities at subway terminals or encouraging car-pool programs, a great deal would be achieved, they said.

The real crunch over petroleum shortages is in the very near future, the report said, and yesterday Dr. Franklin added that the federal Government has contingency plans ready for gas rationing or a two-price quota system.

But these should not be looked on as just temporary measures, she said.

As stressed in the report, the result of about two years of study, the energy shortage is something the nation is going to have to learn to live with.

Dr. Franklin was asked to comment on the belief stated by some authorities that nuclear power will be able to provide all the energy required to continue a growth-oriented market economy.

She pointed to an earlier analogy she had used — that if a car is stuck in the mud the driver shouldn't step on the gas, he should shift gears. To put total reliance on nuclear power, she said, would be the same as stepping on the gas.

She cited a section of the report which says nuclear power must be carefully evaluated in terms of its impact on the environment.

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Hydro will try new control to reduce consumption

By EDWARD CLIFFORD

Ontario Hydro will soon begin experiments with perhaps the lowest-cost electric power demand regulator yet devised—inaudible AM radio signals that will turn home water heaters on and off.

In a trial involving 20 homes in the Toronto area, the codes will be superimposed on the broadcast signal of radio station CBL. Tiny receivers mounted on water heaters in homes throughout the area will pick up the signals and turn the water heaters on and off.

The purpose would be to reduce electric power consumption in selected areas in times of heavy power demand. It is estimated that extensive use of such controls could reduce demand by up to 900 megawatts—nearly half the output of the Pickering nuclear generating station.

The trials will begin in May. They will be extended in 1978 to cover 200 residential customers. Depending on the results, Hydro believes the water heaters in several hundred thousand homes could be radio-controlled by 1980.

In mass production, the combination radio receiver and off-on relay could be built and installed at a cost of about $75 per home.

This is about half the cost of a number of other devices being used or under study in Ontario and other jurisdictions. Eventually it is expected that other heavy power users—outdoor signs and air conditioners, for example—could be similarly controlled.

The interruption of water heaters in times of heavy power demand is not a new practice. Homes in Toronto, Scarborough and Etobicoke with electric water heaters are under such controls now. These are manual systems which require that a home's water heater be wired separately from normal house circuits, and served by a separate utility wire.

With the radio control, the water heater could be included in the regular house circuit.

Harold West, manager of the load management section of Ontario Hydro's energy conservation division, said the system has the flexibility to provide controls on a neighborhood-to-neighborhood basis.

As many as 32 inaudible codes could be broadcast by a radio station such as CBL without a radio listener being aware of them. Given the number of Toronto AM radio stations, 200 or more separate areas could be controlled in this way.

During the trial periods, the radio system will be operated manually.

In its final flowering, however, it would be operated by a computer capable of reading demand levels and making decisions as to where water heaters should be turned off, much as computers now regulate traffic signals.

The system is used nowhere else in the world, as far as Ontario Hydro knows, although a Detroit utility does operate its own VHF broadcasting station to do essentially the same job.

The advantage of AM is that stations usually are more powerful and can cover a wider area, the multiplicity of stations provides more flexibility, and AM receivers are cheaper. Besides, the air waves are crowded enough now, Mr. West said.

Hydro research has shown so far that cable TV and telephone networks could be used to carry signals, but would also require more development work and be more expensive.

Another system being examined, ripple controls, makes use of audio tones sent along the power distribution networks but require complex and expensive equipment. They still might be favored by a larger municipality because they also lend themselves to automatic meter reading and other applications, Mr. West said.

With the AM radio station system, hardly a hydro customer in Ontario could not be reached by signals. This means loads could be switched off either in geographic blocks or on a widely dispersed random basis.

Hydro decided to pursue the idea when it learned that AM stations use inaudible signals now to automatically control transmitters not located on the station premises.

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